

A dissertation submitted to the **University of Greenwich** in partial fulfilment of the requirements for the Degree of

**Master of Science**  
*in*  
**Computer Science**

Developing a mobile application to improve nutritional awareness for University of Greenwich students using Near Field Communication

**Name:** Usman Basharat

**Student ID:** 000874782

Computing & Mathematical Sciences, University of Greenwich, 30 Park Row, Greenwich, UK.

**Supervisor:** Dr. Markus Wolf

**Submission Date:** September 2020

**Word count:** 13,258

## Abstract

Nutritional awareness defined as self-perception inclined to eating balanced diet. A good nutrition is a part of leading a healthy lifestyle. A well-defined diet can reduce risks of chronic diseases. Technology is a big part of a growing generation of technology that enhances every day. There are samples of evidence within this research exploring different angles of NFC. Throughout this study, NFC explores different aspects alongside the popular comparison use of barcode scanners. An interesting comparison is thoroughly explored. This study aims to present, research, test, develop aiming to improve nutritional awareness for University of Greenwich students using Near Field Communication (NFC). NFC tags are used to store, read, write, and update information that is gained using Nutritionix Application Programming Interface (API). Nutritionix is the largest verified database by over 5M consumers use of queries every month. A verified database that explores reach beyond supermarket products and even aims to search for products within the restaurant, and common items too. A verified database, such as Nutritionix, is exactly the type of API that is needed to be selected to use and store information using NFC tags. A positive outlook to gain updated information from a verified source. A result of developing an android application to increase nutritional awareness.

**Keywords:** NFC, API, Nutritionix, Nutritional awareness

## Acknowledgments

I would especially like to thank Markus for agreeing to be my supervisor and for his consistent advice, feedback, guidance, and support throughout the lifecycle of this project.

I want to thank both family and friends for agreeing to have the project demonstration on the scheduled day.

## Table of Contents

<b>ABSTRACT .....</b>	<b>2</b>
<b>ACKNOWLEDGMENTS .....</b>	<b>3</b>
<b>TABLE OF CONTENTS .....</b>	<b>4</b>
<b>LIST OF FIGURES .....</b>	<b>6</b>
<b>LIST OF TABLES .....</b>	<b>6</b>
<b>LIST OF ACRONYMS .....</b>	<b>7</b>
<b>CHAPTER 1: INTRODUCTION .....</b>	<b>8</b>
1.1. OVERVIEW.....	8
1.2. PROJECT AIM .....	8
1.3. PROJECT METHODOLOGY .....	9
1.4. PROJECT OBJECTIVES .....	9
1.4.1. GANTT CHART .....	9
<b>CHAPTER 2: LITERATURE REVIEW .....</b>	<b>10</b>
2.1. INTRODUCTION.....	10
2.2. NFC VS BARCODE SCANNER.....	10
2.2.1. READER/WRITER MODE .....	11
2.2.2. CARD SIMULATION MODE .....	11
2.2.3. PEER-TO-PEER MODE .....	11
2.2.4. EAVESDROPPING .....	11
2.2.5. DATA CORRUPTION.....	11
2.2.6. MATURE TECHNOLOGY .....	12
2.2.7. AFFORDABLE .....	12
2.2.8. LIMITED VISIBILITY .....	12
2.3. RESTFUL API.....	13
2.3.1. ARE RESTFUL APIs SECURE? .....	14
2.4. NUTRITIONAL AWARENESS AMONG STUDENTS .....	14
2.5. HOW DOES COVID-19 AFFECT NFC? .....	15
2.6. DIET ASSESSMENT.....	15
2.7. HUMAN-COMPUTER INTERACTION (HCI) .....	16
2.8. JUSTIFICATION OF NFC AND RESTFUL API .....	16
2.9. KEY ISSUES TO ADDRESS IN THE DESIGN AND IMPLEMENTATION .....	16
<b>CHAPTER 3: PRIMARY RESEARCH .....</b>	<b>17</b>
<b>CHAPTER 4: PRODUCT RESEARCH .....</b>	<b>18</b>
4.1. INTRODUCTION.....	18
4.2. TRACK – CALORIE COUNTER.....	18
4.2.1. APPEARANCE .....	18
4.2.2. OVERVIEW .....	18
4.2.3. ASSESSMENT.....	19
4.3. CHANGE4LIFE – FOOD SCANNER .....	19
4.3.1. APPEARANCE .....	19
4.3.2. OVERVIEW .....	20
4.3.3. ASSESSMENT.....	20
4.4. MYFITNESSPAL .....	21
4.4.1. APPEARANCE .....	21
4.4.2. OVERVIEW .....	21
4.4.3. ASSESSMENT.....	21
4.5. CONCLUSION.....	22
4.6. KEY ISSUES TO ADDRESS IN THE DESIGN AND IMPLEMENTATION .....	22
<b>CHAPTER 5: LEGAL, SOCIAL, ETHICAL, AND PROFESSIONAL ISSUES.....</b>	<b>23</b>

<b>CHAPTER 6: REQUIREMENT ANALYSIS .....</b>	<b>24</b>
6.1. INTRODUCTION.....	24
6.2. TARGET AUDIENCE .....	24
6.3. STATEMENT OF REQUIREMENTS.....	24
6.4. FUNCTIONAL REQUIREMENTS .....	25
6.5. NON-FUNCTIONAL REQUIREMENTS .....	26
6.6. CONCLUSION.....	26
<b>CHAPTER 7: DESIGN DEVELOPMENT .....</b>	<b>26</b>
7.1. INTRODUCTION.....	26
7.2. USE-CASE DIAGRAM .....	27
7.3. WIREFRAMES .....	28
7.4. SEQUENCE DIAGRAM.....	30
7.4.1. WRITING NFC TAG.....	30
7.4.2. CALORIE COUNT .....	31
7.4.3. READING NFC TAG .....	31
7.5. CLASS DIAGRAM.....	33
7.6. SITE-MAP DIAGRAM .....	35
7.7. ENTITY RELATIONSHIP DIAGRAM (ERD) .....	35
<b>CHAPTER 8: IMPLEMENTATION .....</b>	<b>36</b>
8.1. INTRODUCTION.....	36
8.2. PROCESS OF IMPLEMENTATION.....	36
8.3. TECHNICAL ISSUES .....	38
8.4. ARCHITECTURE DIAGRAM .....	38
<b>CHAPTER 9: TESTING .....</b>	<b>39</b>
9.1. INTRODUCTION.....	39
9.2. INTEGRATION TESTING .....	39
9.3. UNIT TESTING .....	40
9.4. USER TESTING.....	41
9.4.1. USER TESTING CASE 1 .....	41
9.4.2. USER TESTING CASE 2 .....	42
9.5. CHANGES MADE TO PROTOTYPE C.....	43
9.5.1. FEEDBACK FROM DEMONSTRATION .....	43
<b>CHAPTER 10: EVALUATION .....</b>	<b>44</b>
10.1. INTRODUCTION.....	44
10.2. CRITICAL EVALUATION OF THE PROCESS OF THE PROJECT .....	44
10.3. CRITICAL EVALUATION OF THE PRODUCT.....	45
10.4. SELF-EVALUATION.....	45
10.5. FUTURE DEVELOPMENT.....	46
10.6. CONCLUSION.....	46
<b>CHAPTER 11: REFERENCES .....</b>	<b>47</b>
<b>CHAPTER 12: APPENDICES .....</b>	<b>49</b>
12.1. APPENDIX A – QUESTIONNAIRE RESULTS.....	49
12.2. APPENDIX B – PRODUCT RESEARCH APPEARANCE .....	54
12.2.1. CALORIE COUNTER .....	54
12.2.2. CHANGE4LIFE.....	55
12.2.3. MYFITNESSPAL .....	55
12.3. APPENDIX C – ETHICAL APPROVAL .....	56
12.4. APPENDIX D – IMPLEMENTATION.....	56

## List of Figures

Figure 1 shows the Gantt Chart for this project.....	9
Figure 2 shows the process of how REST API works (REST API, 2020) .....	13
Figure 3 shows the nutritional awareness among subjects for students (Barzegari, Ebrahimi, Azizi and Ranjbar, 2011) .....	14
Figure 4 shows the reasons for nutritional awareness (Barzegari, Ebrahimi, Azizi and Ranjbar, 2011) ....	14
Figure 5 shows the difference and increase within each country of using contactless payments (Cohen, 2020).....	15
Figure 6 shows an example inserted by a student .....	17
Figure 7 shows the appearance for Calorie Counter (Calorie Counter, 2020) .....	18
Figure 8 shows the appearance for Change4Life (Change4Life, 2020).....	19
Figure 9 shows the appearance for MyFitnessPal (MyFitnessPal, 2020).....	21
Figure 10 shows the use-case diagram with different actors .....	27
Figure 11 shows two wireframes ideas .....	28
Figure 12 shows two wireframe ideas .....	29
Figure 13 shows a sequence diagram for writing NFC tag .....	30
Figure 14 shows a sequence diagram for calorie count.....	31
Figure 15 shows a sequence diagram for reading NFC tag .....	31
Figure 16 shows the class diagram for this project. ....	33
Figure 17 shows a site-map diagram of the project.....	35
Figure 18 shows the ERD diagram relationship.....	35
Figure 19 shows the architecture diagram of the whole system.....	38

## List of Tables

Table 1 shows a summary benefits of all three NFC modes .....	11
Table 2 shows the summary of drawbacks of NFC.....	12
Table 3 shows the benefits for barcodes.....	12
Table 4 shows a summary of the drawbacks of the barcode scanner .....	12
Table 5 shows evaluation for Calorie Counter .....	19
Table 6 shows evaluation for Change4Life.....	20
Table 7 shows the evaluation for MyFitnessPal.....	21
Table 8 shows numerous tests for White Box Testing .....	39
Table 9 shows numerous tests for Black Box Testing.....	41
Table 10 shows the process for User Testing.....	41
Table 11 shows numerous tests for user testing 1 .....	41
Table 12 shows numerous tests for user test case 2 .....	42

## List of Acronyms

- API – Application Programming Interface
- NFC – Near Field Communication
- RAD – Rapid Application Development
- UPC – Universal Product Code
- JSON – JavaScript Object Notation
- REST – Representational State Transfer
- HTTP – Hyper-Text Transfer Protocol
- FR – Functional Requirements
- NFR – Non-Functional Requirements
- LFD – Low Fat Diet
- LCD – Low Calorie Diet
- URL – Uniform Resource Locator

## Chapter 1: Introduction

### 1.1. Overview

Nutritional awareness and nutritional intake are pivotal elements in human health and given great importance for having a balanced diet. A study by Pharos University in Egypt showed that an assessment of nutritional awareness for characteristics of participating students resulted out of 165 students; 12% had good awareness, 76% had partial awareness while 12% showed poor awareness (Ismael, 2018). Naglaa Ismael shows to the audience that this needs to be given importance and awareness by using current technologies that are available to improve health.

A critical factor shows that the awareness of students assessed by Mr. Ismael shows that we need a greater factor of awareness using technology. A chosen method would be the use of using Near Field Communication that uses an in-depth communication device between two devices. NFC Tags are a tool of storage of data that communicates through the device. An experiment would be used to test this throughout this project.

British Heart Foundation collects statistical data that represents the scale of the challenges that adults face in the United Kingdom. These points that are going to be named are deaths from heart and circulatory diseases in the UK. These statistics show that awareness and prevention at an early stage are important to be noticed. Here are some of the shocking statistics below (British Heart Foundation, 2019):

- Nearly 3.8 million adults are diagnosed with diabetes
- Around 7.4 million people living with heart and circulatory disease in the UK
- An average of 460 deaths each day or one every three minutes for heart and circulatory diseases.

These statistics are concerning and to do this, users would need awareness to show which product to select and which product not to select. Conducted research, a different approach was necessary within this industry. Many applications, as given example within Chapter 4, that use barcodes, but not many had the use of NFC. Therefore, this approach was used for interactive and assessment of this.

Many different features are all going to be named. One of the features would be using Nutritionix API that would provide a huge database of all brands that have all necessary nutritional information. This would be a search list that can be added to the NFC Tag for informative use. As Nutritionix provides a massive database, a manual override to entered by using various details matching what is received as an emergency. All history for the NFC Tags that are scanned, it will be stored for the user to see. Assessment will be made by the item scanned to tell whether it would be good, neutral, and bad. This would let the user know the outcome and healthiness of the product. All changes for features of this product would be discussed and subject to change, due to all the research that will be investigated throughout this product. Please be aware that all changes will be notified throughout this report.

### 1.2. Project Aim

This project would aim to create an android application for the University of Greenwich students to improve nutritional awareness. Therefore, all customers can use scan the item and find information about any product scanned. The project aim would be to address the lack of information of supermarket products that is daily used. A lack use of NFC tags would be implemented to address the information for any products using an API. By using an API, it would find all the supermarket brands and foods that is purchased daily.



### 1.3. Project Methodology

A methodology will be Rapid Application Development (RAD) alongside the use of MoSCoW. RAD is a methodology that uses traditional practices solely focuses on planning and user feedback. All focus would be on the preparation to make it easier for the development and outcome of this project (Geambasu, Jianu, and Gavrilă, 2011). This would suit the project's flow as the main asset of its characters would be to plan to make sure the outcome would be suitable.

As RAD exclusively focuses on the planning stage, MoSCoW will be used alongside RAD. MoSCoW method is a prioritization framework for managing requirements. The acronym for MoSCoW stands for must-haves, should-haves, could-haves, and will not have at this time. This would benefit RAD as both methods complement each other and they have each of their brackets to focus on (Wills, 2020).

### 1.4. Project Objectives

A set of detailed objectives are set within a Gantt Chart below. However, below would be a summary of what would be required for this whole project. Below is a summary of the following:

- Obtaining nutritional awareness research for user requirements
- Outline a suitable API to match the library database for all products
- Attain information on the assessment of the user's history to improve current die
- Extensive literature review on the current impact of nutritional awareness and intake, and how the latest technologies can be affected.
- Design and implementation of the nutritional awareness system using the information that has been found from gaining the requirements.
- Test the nutritional awareness system
- Evaluate the system
- Enhance any changes to the system

#### 1.4.1. Gantt Chart

<b>Background Research Stage</b>	<b>22 days</b>	<b>Mon 01/06/20</b>	<b>Tue 30/06/20</b>	
Search online for articles, journals, and books of relevant research	2 days	Mon 01/06/20	Tue 02/06/20	
All background research information on nutritional awareness as stated in aims such as API, assessments	6 days	Wed 03/06/20	Wed 10/06/20	2
Gather all information and create a draft on the literature review	8 days	Thu 11/06/20	Mon 22/06/20	3
Research all issues in relevant areas for nutritional system for LSEP	2 days	Tue 23/06/20	Wed 24/06/20	4
Evaluate and finalise the literature review	4 days	Thu 25/06/20	Tue 30/06/20	5
<b>Product Research</b>	<b>8 days</b>	<b>Wed 01/07/20</b>	<b>Fri 10/07/20</b>	<b>1</b>
Evaluate any existing products	2 days	Wed 01/07/20	Thu 02/07/20	6
Design questionnaires	2 days	Fri 03/07/20	Mon 06/07/20	8
Evaluate questionnaire results	2 days	Tue 07/07/20	Wed 08/07/20	9
Begin UML Diagrams	2 days	Thu 09/07/20	Fri 10/07/20	10
<b>Design Stage</b>	<b>9 days</b>	<b>Mon 13/07/20</b>	<b>Thu 23/07/20</b>	<b>7</b>
Design User Interface/Wireframes	2 days	Mon 13/07/20	Tue 14/07/20	11
Redefine ERD, Use Case and Class Diagram	3 days	Wed 15/07/20	Fri 17/07/20	13
Finalise all UML Diagrams	2 days	Mon 20/07/20	Tue 21/07/20	14
Begin Design Documentation	2 days	Wed 22/07/20	Thu 23/07/20	15
<b>Development Stage</b>	<b>16 days</b>	<b>Fri 24/07/20</b>	<b>Fri 14/08/20</b>	<b>12</b>
Implementation of User Interface for Android	3 days	Fri 24/07/20	Tue 28/07/20	16
Implementation of Database (FireBase)	2 days	Wed 29/07/20	Thu 30/07/20	18
Implementation of API and NFC	4 days	Fri 31/07/20	Wed 05/08/20	19
Implementation of Final Product	7 days	Thu 06/08/20	Fri 14/08/20	20
<b>Testing Stage</b>	<b>8 days</b>	<b>Mon 17/08/20</b>	<b>Wed 26/08/20</b>	<b>17</b>
Testing API and NFC	2 days	Mon 17/08/20	Tue 18/08/20	21
Testing Database (FireBase)	2 days	Wed 19/08/20	Thu 20/08/20	23
Testing all aspects of the system	3 days	Fri 21/08/20	Tue 25/08/20	24
Begin Test Documentation	1 day	Wed 26/08/20	Wed 26/08/20	25
<b>Finalisation Stage</b>	<b>5 days</b>	<b>Thu 27/08/20</b>	<b>Wed 02/09/20</b>	<b>22</b>
Finalisation of Documentation	3 days	Thu 27/08/20	Mon 31/08/20	26
Finalise Product	2 days	Tue 01/09/20	Wed 02/09/20	28

**Figure 1 shows the Gantt Chart for this project**

## Chapter 2: Literature Review

### 2.1. Introduction

This is part of the Literature Review where ongoing discussions about extensive research on nutritional awareness using academic professionals as references. The ongoing issue to produce new ways to communicate different ways with users. As briefly stated within Chapter 1, they are ongoing issues concerning awareness of this. This section will explore and explain this throughout the research that will be gathered for this chapter.

They are different ways that users can communicate through devices. This can be found that one of the ways that are limited would be the use of using NFC through the use of NFC Tags. Please refer yourself over to Chapter 4 to find more relevant and similar products that are available within the industry. Different approaches to informing users about nutritional awareness are available using a barcode scanner. However, this would be given in greater depth within this section.

The knowledge and research found will be gathered and cited by professional academic authors. The topics that will be explained throughout this chapter about how this project will be achieved. Some of the topics include the comparison between NFC and barcode scanner; VPN thoroughly explained; nutritional impact and how HCI is used throughout this project. The advantages, disadvantages and comparison will be included of NFC and barcode scanner.

### 2.2. NFC vs Barcode Scanner

Near-Field Communication, introduced in 2011, works by using electromagnetic fields by transmitting data using the relevant tags. A modern technology that has been installed within millions of smartphones is used for a variety of uses on the market today. (Thanapal, Prabhu, and Jakhar, 2017). NFC can be used to share files, connect to speakers, payments, programmable tags, and connect to Wi-Fi using different strategies. As you may notice, NFC has many varieties of its uses; but the focus would be using NFC tags and programming these to the best scenario.

Barcode Scanner, introduced in 1974, scans Universal Product Code (UPC) to scan different and detect different products. A traditional method of detecting the unique product as seen in supermarkets, and most modern phones of its use too. Barcode Scanner has different types of uses seen in laser scanners, smartphones, camera-based scanners, LED scanners, and many more. As you may notice, Barcode Scanner has many varieties of uses; but the main focus would be using Barcode Scanners within smartphones.

A group of authors tested the satisfaction of a group of users for NFC services offered on the campus. We notice that 83% were either "very satisfied" or "rather satisfied" with this. Some of these services that were offered included payments and door access. A comparison was also tested with traditional payments in comparison to NFC payments. These results were more than 50% were more satisfied with the payment process (Gaven, Strassl, Ferro, Tscheligi, and Schwab, 2007). We notice from this is that a moving technology would rather have the use of NFC than traditional methods that are carried out. This is a positive sign for the services of NFC. All of this would be assessed on how students find NFC use with NFC tags in the following Chapter 3 for questionnaires that will be sent out to them.

In comparison to the Barcode Scanner, a traditional approach will always have its positive and praises. However, moving technology can unearth different approaches that users prefer to communicate. Two different ways with different approaches have different benefits and drawbacks. A full detailed section of this will be raised with the versatility of NFC. Any situation will always draw its disadvantages. This will be mentioned alongside any situation of how it can be resolved.

### 2.2.1. Reader/Writer Mode

Many applications have different ways of interpreting data between reading and writing mode for this. An example of this utility would be a modern smart poster application. A way of users to read data from the poster using their NFC-enabled devices. The key importance is even if the user is away from the poster, the information that has been scanned will be still available for the user to read (Kerem, Mehmet, Vedat and Busra, 2011). This is the type of NFC mode that will be used within the nutritional awareness application using NFC Tags. A great benefit would be to write and update to NFC Tags too. A utility that will also be used for the nutritional awareness application too.

### 2.2.2. Card Simulation Mode

Card Simulation is a type of NFC mode that is identified to eliminate a physical object and make payment deemed easier. Therefore, in terms of payment, instead of making payments by cash or credit card; it will eliminate this by using NFC through smart device acting like similar to a contactless payment (Kerem, Mehmet, Vedat and Busra, 2011). This would be similar to electronic key applications, or attendance control. All of these applications eliminate the necessary devices by implementing the same device through any modern smartphone. Therefore, it will make it easier for users as shown NFC has its benefits with its flexibility.

### 2.2.3. Peer-to-Peer Mode

Peer-to-Peer mode allows the application of transfer data between two devices whilst using NFC. An example would be for a classic two businessmen to transfer their contact details. (Kerem, Mehmet, Vedat and Busra, 2011). This can be used by using NFC to touch two devices together for the transfer of their details. After all of this analysis, the following table has been used for a summary of all the NFC modes and its benefits that are mentioned:

**Table 1 shows a summary benefits of all three NFC modes**

	<b>Reader/Writer Mode</b>	<b>Card Simulation Mode</b>	<b>Peer-to-Peer Mode</b>
<b>Benefits</b>	<ul style="list-style-type: none"><li>• Ability to adapt to different scenarios</li><li>• Easy to implement</li></ul>	<ul style="list-style-type: none"><li>• Decreases carrying physical objects</li><li>• Ability to use for different scenarios such as attendance,</li></ul>	<ul style="list-style-type: none"><li>• Easy to exchange data between different devices</li></ul>

### 2.2.4. Eavesdropping

As this can occur in any situation, the proximity of making a transaction, users beside can steal personal information that is used within a small distance. Therefore, data can be exposed with the technique of eavesdropping by generating its own Radio Frequency Field (active mode) or whether the data is using Radio Frequency Field generating by another device (passive mode). A more secure way to prevent this would be using the passive mode. As data intervention can always take place, a more secure way to prevent this from happening is to secure the NFC channel using a protocol of Diffie-Hellmann (Haselsteiner, 2006).

### 2.2.5. Data Corruption

A denial of service attack (DoS) is an attack aimed at a network enabling inaccessible for the users. DoS is usually achieved by sending floods of traffic, or information enabling the service to be unable to use for users. This enables data to be corrupt and unable for its use. An attacker can gain ways through the NFC interface by sending irrelevant data causing more traffic and disabling the service for a while. However, NFC devices can detect these attacks and make sure that the device is securable. Detection can be made and can be prevented causing less data corruption (Haselsteiner, 2006). Table 2 shows a summary of all the drawbacks that have been mentioned for NFC.

**Table 2 shows the summary of drawbacks of NFC**

	<b>Eavesdropping</b>	<b>Data Corruption</b>
<b>Drawbacks</b>	<ul style="list-style-type: none"> <li>• Users can steal personal information from a proximity</li> </ul>	<ul style="list-style-type: none"> <li>• Denial of Service causing services to shut, and enabling data to be corrupt</li> </ul>

#### 2.2.6. Mature Technology

Barcode Scanner is known to how many types as mentioned before with its mature technology. As this was first introduced in June 1974 within supermarkets, it has been prone to be used differently. Its mature technology has made this more consistent over the years it has been introduced. One of the attributes that barcode scanners can be used within smartphones. An emphasis on this throughout this section. However, a mention that the versatility is matched with NFC throughout the use of a barcode scanner. This can be used within a variety of barcodes that are available to scan. A different type such as image barcode reader, CCD barcode scanners (a traditional approach that was used in most supermarkets), laser barcode, and many more.

#### 2.2.7. Affordable

In terms of prices, barcode scanners offer a variety of characteristics. However, when comparing cost; it could save organizations expenses. Needless to say, it has different types of barcodes. When comparing this cost to the latest NFC; it has a huge difference in numbers. NFC works with modern smartphones, but barcodes, as traditional, can be easily found. Please refer to Table 3 where this shows a summary of the benefits for barcodes.

**Table 3 shows the benefits for barcodes**

	<b>Mature Technology</b>	<b>Affordable</b>
<b>Benefits</b>	<ul style="list-style-type: none"> <li>• Versatility</li> <li>• Traditional technology – almost used everywhere</li> </ul>	<ul style="list-style-type: none"> <li>• Cheap expenses when comparing costs with NFC</li> </ul>

#### 2.2.8. Limited Visibility

On every occasion, a barcode is scanned; the UPC needs to be straight and all of the code needs to be visible. Otherwise, the barcode would be unable to scan the item that it has been aiming to scan if this is an issue. Some barcodes can be damaged whilst trying to scan the product to find information for this. This has been a consistent issue when trying to scan a product. Besides, it can delay productivity whilst being a cashier at a supermarket.

**Table 4 shows a summary of the drawbacks of the barcode scanner**

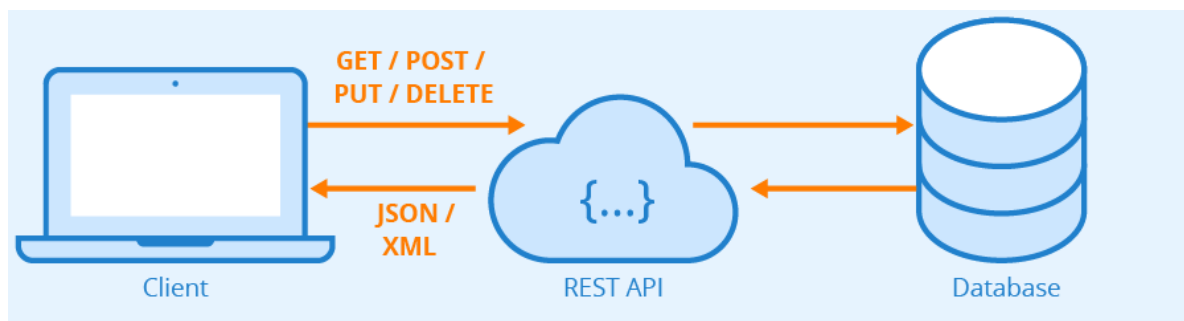
	<b>Limited Visibility</b>
<b>Drawbacks</b>	<ul style="list-style-type: none"> <li>• UPC barcodes can be damaged</li> <li>• Require a line of sight to be read the barcode</li> </ul>

### 2.3. RESTful API

An Application Programming Interface (API) is a set of functions that allow two applications to access data by communicating with each other. As Matt Wyatt states this in simple terms, an API delivers the user's response and sends the system back to the user. An example would be if you click "add a cart," an API tells the site you have added a product to the cart. The website puts this within your cart, and your cart has updated (Wyatt, 2020). However, just to make it simpler; it is a structured request and response from the provider. The term REST stands for Representational State Transfer (REST) that uses HTTP requests method protocol to transfer state between two applications.

REST uses four HTTP method that covers most cases between. These would be the following:

- GET – Gathers all information from the API
- PUT – Updates any information from the API
- POST – Creates any new information from the API
- DELETE – Deletes any information from the API



**Figure 2 shows the process of how REST API works (REST API, 2020)**

Once this information has been gathered, it is within a format of JSON – JavaScript Object Notation. This is a way for users to read the information, which has been requested from the database, easily. Referring to Figure 2, it shows the simple process of how the communication levels between two applications work. A simple scenario. However, this can be shown more complex by adding authentication, firewall, and different programming languages.

They are many types of APIs that are used in different context around every day uses. For example, Google Cloud provides users with APIs that handle more than 50 that users have an option to use. An example that can be used for free would be Google Maps where users can install this within their context and use the services of Google Maps within any application.

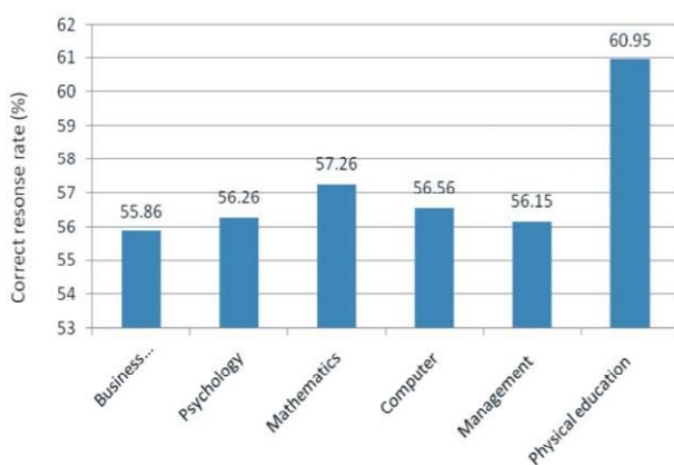
The only focal point throughout improving nutritional awareness would be gathering all the information from the API i.e. GET. This would improve the application as it would gather all of the databases and can "get" all of the information without having to manually insert it. An example would be to use Nutritionix, which provides a massive brand database of all the nutritional values that are within each product. However, this would be explored in much detail later on within the project to see if this is the right API to use.

### 2.3.1. Are RESTful APIs secure?

A potential security threat that REST API uses HTTP protocols that bring forth potential attackers attacking full access with the HTTP request. Here are some points where security needs to be taken priority (Levin, 2019):

- As stated, a potential hacker has full access to the HTTP request. Since REST APIs are commonly used to exchange data through an HTTP request, it could lead to unforeseen breaches
- For an application using REST, this typically has full access to the resource representation and could inject payload to attack the resource that it is handling and have full access to its library.
- They are numerous ways of attack that could be injection attack, DDoS attack, broken authentication, and exposure of sensitive data.

## 2.4. Nutritional Awareness among Students



Ali Barzegari, one of the authors, did a nutritional knowledge on the attitude, and nutritional awareness among students. Referring to Figure 3 shows the nutritional awareness rate among various subjects as mentioned. Across all subjects, they were mostly average. However, as you notice, this does display the lack of knowledge that has come across during all subjects. Physical Education has come across with 61% of students' knowledge of nutrition.

**Figure 3 shows the nutritional awareness among subjects for students (Barzegari, Ebrahimi, Azizi and Ranjbar, 2011)**

Referring to Figure 4 shows a lack of information that has been declared among students. You can see that almost 62% of students that took part in this test have stated that there is a lack of information that has been displayed. This informs us that even within the current circumstances, more applications and technologies need to put effort into this sector and make sure that more students and adults are aware of what they are eating and consuming.

**Table 3: Main cause of low nutritional awareness**

	Factors	Frequency	Percent
1	Lack of information	143	62.7
2	Carelessness to nutrition	27	11.8
3	Not interest	3	1.3
4	Lack of time	17	7.5
5	culture	9	2.6
6	Family	3	1.3
7	Financial	2	0.9
8	Lack of nutrition course	17	7.5
9	Education	6	2.7
10	Fast food	1	0.4
11	Lack of nutrition congress	3	1.3
	Total	229	100

**Figure 4 shows the reasons for nutritional awareness (Barzegari, Ebrahimi, Azizi and Ranjbar, 2011)**



## 2.5. How does COVID-19 affect NFC?

Coronavirus has been a global pandemic for the last few months during a mid-season transition for all organisations. Coronavirus has had a huge impact within the global community within recent months. However, NFC is having a huge impact by businesses are changing their methods of purchasing habits to keep customers safe. Government officials have stated and encouraged organisations and consumers to “use contactless payments if possible” (gov.uk, 2020).

Referring to Figure 5, Strategy Analytics have showed the four countries of US, UK, China, and Germany the difference between before, during and after the global pandemic of contactless payments. You may notice that the US has a surge from 21% to 29%. The difference of this is that all four main countries have a trend of increase use of NFC. Therefore, a positive point of view for NFC as its flexibility has increased its users during a global pandemic. This shows that customers are more confident in using NFC and are aware of the benefits that NFC has during a global pandemic.

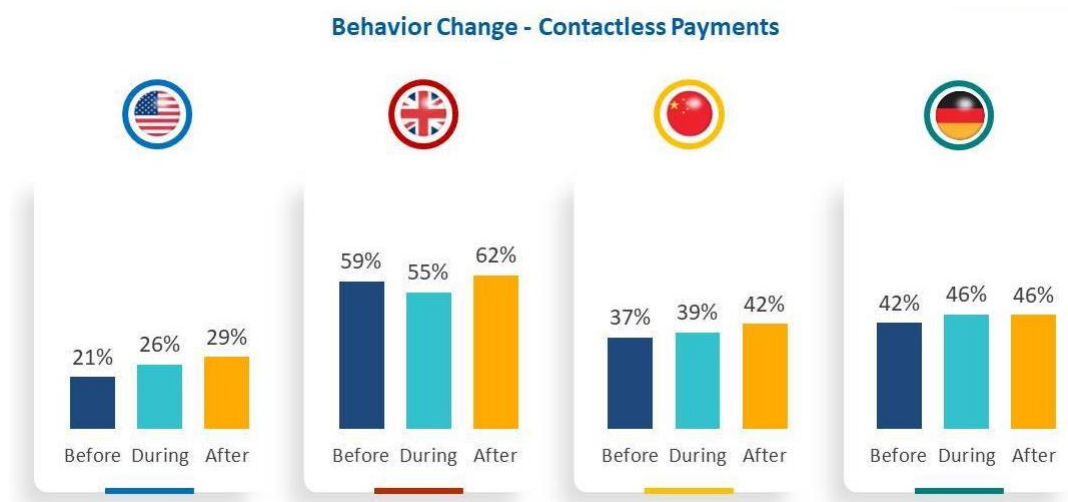


Figure 5 shows the difference and increase within each country of using contactless payments (Cohen, 2020)

## 2.6. Diet Assessment

As NHS recommends to eating healthy, it is important to have a well-balanced diet to ensure and maintain a good health. Dietary Guidelines recommends an adult to total calories of the following:

Carbohydrates	600 calories	150 g
Proteins	450 calories	112 g
Fats	450 calories	50 g

In recent studies, dieters were so keen to different ways of weight loss, they compared the results of using low-fat diet (LFD) and low-carb diet (LCD). The researchers found results that showed that both results that were studied showed similar weight changes for both LFD and LCD (Olsen, 2018). These recommendations show that users need to ensure that when assessment of each product is made, these recommendations of products need to remind others of when assessment is made. Studies show that if you track your diet, it can show which food group you are lacking and ensure that you would need a healthy diet.

## 2.7. Human-Computer Interaction (HCI)

Today, HCI plays a massive role in the development of the product, as HCI studies the design and emphasis on the interaction between people and computers. The main goals that HCI aims to produce would be to understand the factors that determine how people use technology, building suitable and efficient systems, and making sure this meets customer expectations. HCI focused on primarily computers, since the expansion of current technology, it had to expand the research beyond computers. There are many different types of HCI factors and principles that organizations should follow. Jakob Nielsen's 10 general principles are the guidelines for user interface design and how this should approach each development stage. Some of these factors include consistency, error prevention, flexibility, and user control (Nielsen, 1995).

HCI effectiveness can be compared when comparing the original and results given to the user. A study was tested through the effectiveness of using laptops and tablets for everyday business activities. Tablets scored a higher percentage of 82% for the usability of tablets for its effectiveness. Results show that the tablet was easier to learn, and more consistent (Wetzlinger, Auinger, and Dörflinger, 2014). Even though the context was different, the concept is still the same principle. Products need to be effective for everyday use. Therefore, this needs to be incorporated and integrated into everyday principles for designing this project.

## 2.8. Justification of NFC and RESTful API

To conclude, all of the research that has been found is most relevant as it has helped to understand; differentiate the difference between the choice of having NFC, and barcode scanner as a solution to awareness of nutrition. Merchant Savvy keeps up-to-date with statistics of how many users currently use NFC around the world. It is projected to grow to 1.31 billion people worldwide using mobile payment apps over 6 months (Merchant Savvy, 2020). Currently, two billion NFC devices are enabled like a smartphone use. Therefore, NFC has a huge platform to raise awareness for this.

In terms of REST API, there are many APIs that can be used as a library for this. However, after extensive research, Nutritionix has the largest verified nutrition database consisting of over 740,168 grocery items, 158,601 restaurant items and 13,187 common foods. A huge database that can be explored and searched by using this (Nutritionix, 2020).

## 2.9. Key issues to address in the design and implementation

The key issues can be considered whilst researching upon this literature review. Here are some of the following points that should be considered when implementing:

- HTTP request usually shows security concerns that need to be protected to prevent data breaches from occurring
- Ensure that the JSON format is returned properly in a readable format for users
- This should consider Nielsen's 10 factors when applying this in the application
- Ensure that the application is simple, easy to use and navigate
- NFC has its flexibility whilst using different types of modes
- Ensure that the application is enabled to read tags and write tags for NFC
- Making sure that the users are aware of valuable nutrition on any product as research shows lack of this
- Ensuring the diet requirements are assessed when the product is scanned
- Ensuring information is displayed correctly to inform students about nutritional awareness



## Chapter 3: Primary Research

In this section, conducting research by giving questionnaires to students that attend the University of Greenwich to gain further feedback on unmarked questions within this project. Some of these questions will be relevant to the design and implementation of this project. Please view the following summary and results of what has been tested throughout this project. As stated previously, my aim for responses would be 15. Please view Appendix A for the full extensive detail for this research that has been carried out.

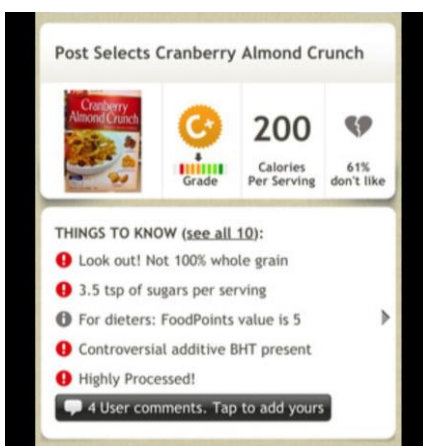
As you may notice in Appendix A, some of these questions are aimed to get more information about the improvement of the product. A summary of the responses that have been answered from the questionnaire within this section. Please note that Georgios Samkovitis, our Ethics representative, has confirmed that if personal information is not used, you do not need ethical approval. Therefore, this research would be continued by Georgios' email within Appendix C.

Google Forms with a brief introduction of the aim, description, and link with the questionnaire, as this was sent to students across the University of Greenwich. The results were more than expected with 46 students that responded to the questionnaire. Nevertheless, the summary of the results was enough results to study for this research.

When asked 'Do you read the information at the back of the product before you eat it?', responses show stated 'Yes' with 32.6%, stating 'No' with 8.7%, and 'Sometimes' with 58.7%. This demonstrates to that with more than 70% of students do not properly the nutritional values before they eat. This was later supported by when asked 'Do you find NFC a useful tool to communicate through your phone?' It was met with 71.7% of all students stated 'Yes', 17.4% stated 'Maybe' and 10.9% stated 'No'.

This question was for those who did state the reason for this, and most common answers were that they have never used this before. Therefore, this gives students more of a reason to utilise the different NFC features, which have been mentioned in Chapter 2. This also lets us know that most students need nutritional awareness, as they lack this by simply not reading the nutritional values stated at the back of each product.

Nevertheless, another area to note when asked 'Would you like to scan an item by using NFC to find out more information about it?', more than 82.6% stated 'Yes', 13% stated 'Maybe' and 4.3% stated 'No'. Therefore, this tells us that most of these students would like to explore the NFC tool further. Students have also confirmed this by stating and confirming that this would be a different option to explore. You can find the rest of the answers were improvements and features that would like to be added. However, these questions were asked about NFC and exploration of nutritional information.



Referring to Figure 6, this was one of the examples that one of the students submitted as an example of how nutritional facts should be informed. This is a great suggestion as this would be considered when implementing the final product for this project. Please refer to Appendix A where you can find all of the answers that were questioned. Most of the other questions were relevant to improvement and suggestions of what to select and improve for the final design. Therefore, all of these suggestions that have been nominated by students will be taken into consideration when designing this final product.

Figure 6 shows an example inserted by a student

## Chapter 4: Product Research

### 4.1. Introduction

Within this section, an investigation of previous similar product that are available in the current market will be assessed. Each product will be reviewed over its usability and it will show different features of what can be used for the final product. The three products that will be used are Calorie Counter, Change4Life, and MyFitnessPal. A summary of each of the reviewed products and address any key points that are needed for the final product will be addressed. Each of the three products contain different aspects of what is expected as having surfed through the Google Play Store, applications based upon the use of barcode can only be found. Therefore, as unique for this project, a variety of applications as the ones that have been suggested to improve and gain research upon what is needed within the final product.

### 4.2. Track – Calorie Counter

#### 4.2.1. Appearance

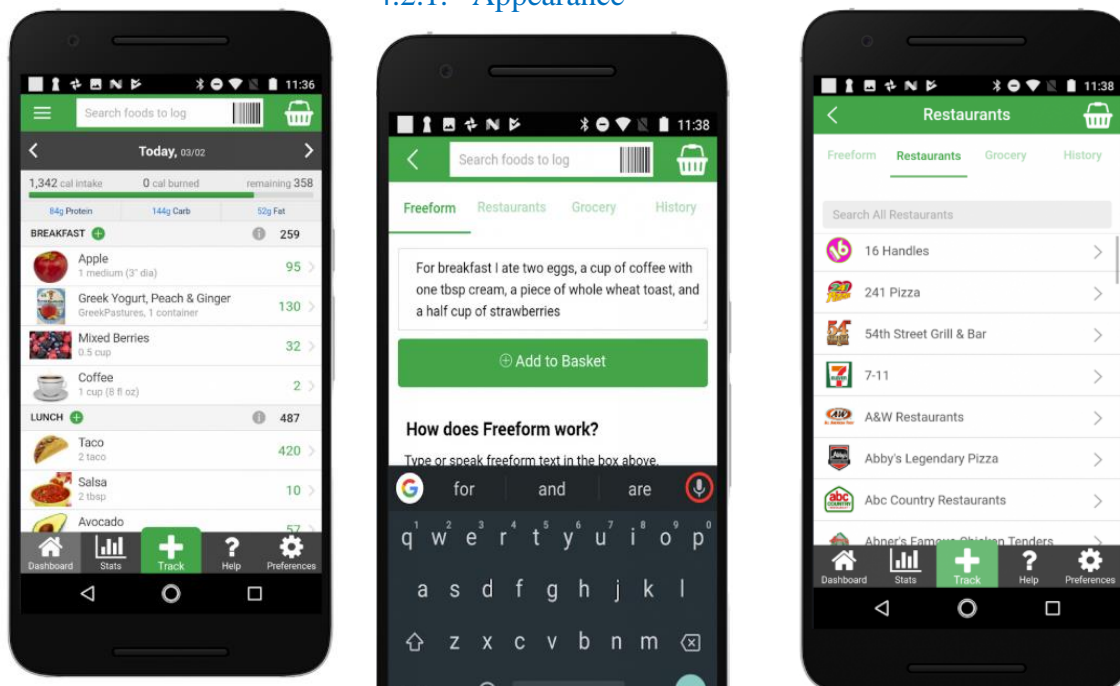


Figure 7 shows the appearance for Calorie Counter (Calorie Counter, 2020)

#### 4.2.2. Overview

Calorie Counter gives an overall experience of nutritional value by scanning, typing, viewing, and counting all necessary products. This application uses Nutritionix API as it is database to gain all the information using a barcode. The key features for this application would be to a similar degree for this project of informing nutritional values to students. However, the key feature that makes this different would be the use of barcode for this application. A variety of assessment that Calorie Counter uses to improve awareness for nutritional values. Some of these include statistical data, suggestions on what products to use, and searching through all products. A guideline of how the application works is a great way to introduce new users to the application.

A consistency of colours with a strong simplicity and efficiency on different types of informative nutritional values that can be emphasised in a strong point in using for the final product too. Please refer over to Appendix B in Chapter 12 for more details about this application. Please refer yourself over to Appendix B over on Chapter 12 for further detailed pictures for Calorie Counter.

### 4.2.3. Assessment

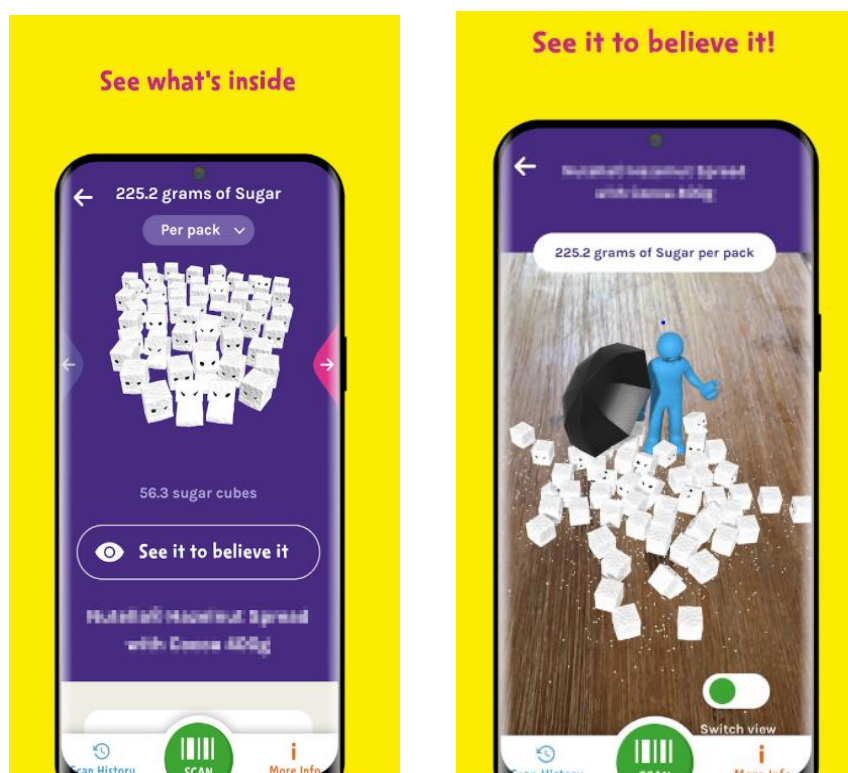
Please refer yourself to Table 5 where this shows a variety of features that this application is assessed on. The rating for the product research would show how the application would be reviewed in different areas as stated. You may notice that over 100,000 users have downloaded this application. The score is very high of 4.5 out of 5. Therefore, it is noticeable that the users that have downloaded this application are satisfied with the flexibility and consistency of this application.

**Table 5 shows evaluation for Calorie Counter**

Areas of Assessment	Rating out of 10
Features	8
Guidance	7
Usability	6
User Interface	4
Ease of Use	7
Consistency	7
Google Review Rating	4.5/5
Downloads	100,000
<b>Google Play Store Review:</b> “I like the flow of this app better than others I've tried. The "cart" is a unique feature. I like that adds up your Macros and shows you right there how many macros is in your cart. Foods are easy to change and manipulate the announce. And it's much easier to create a meal that can be reused than in”	

### 4.3. Change4Life – Food Scanner

#### 4.3.1. Appearance



**Figure 8 shows the appearance for Change4Life (Change4Life, 2020).**

#### 4.3.2. Overview

Change4Life is an application directed by the Public Health England to push forward of enhancing nutritional awareness through Google Play Store. A very simple application that enables a friendly environment of assessment using barcode scanner. Once the barcode is scanned, it assesses the product that is scanned according to its nutritional value. Therefore, if it would be snickers – it would be considered unhealthy. Users can also check the scanned history for each product that has been scanned. The major aim of selecting this application would be purely based upon the assessment of each product. This would be a key part of the project too. The downside to this application would be its flexibility and limited number of features to explore. Referring to Figure 8, this shows the appearance of what has been stated, and the limited number of available features is still shown too. Please refer yourself over to Appendix B over on Chapter 12 for further detailed pictures for Change4Life.

#### 4.3.3. Assessment

Please refer yourself to Table 6 where this shows a variety of features that this application is assessed on. The rating for the product research would show how the application would be reviewed in different areas as stated. As you may have noticed, this application has been rated 3.4 out of 5. This is average at best as many users have rated this out of 5. Users may have found the lack of features and inconsistency with the application have found this application not useful. However, my take from this would be the despite the lack of features, the brilliance of the user interface and the assessment detail once the barcode is scanned.

**Table 6 shows evaluation for Change4Life**

<b>Areas of Assessment</b>	<b>Rating out of 10</b>
<b>Features</b>	3
<b>Guidance</b>	2
<b>Usability</b>	5
<b>User Interface</b>	8
<b>Ease of Use</b>	7
<b>Consistency</b>	6
<b>Google Review Rating</b>	3.4
<b>Downloads</b>	500,000+
<b>Google Play Store Review:</b> “Slow, unresponsive to touch, shows a lot of annoying and useless graphics that I don't want to see. Takes over the screen so that the phone's control buttons disappear. Continues running in the background because there is no proper way to close the app. All I want is a list of key nutritional ingredients”	

4.4. MyFitnessPal

4.4.1. Appearance

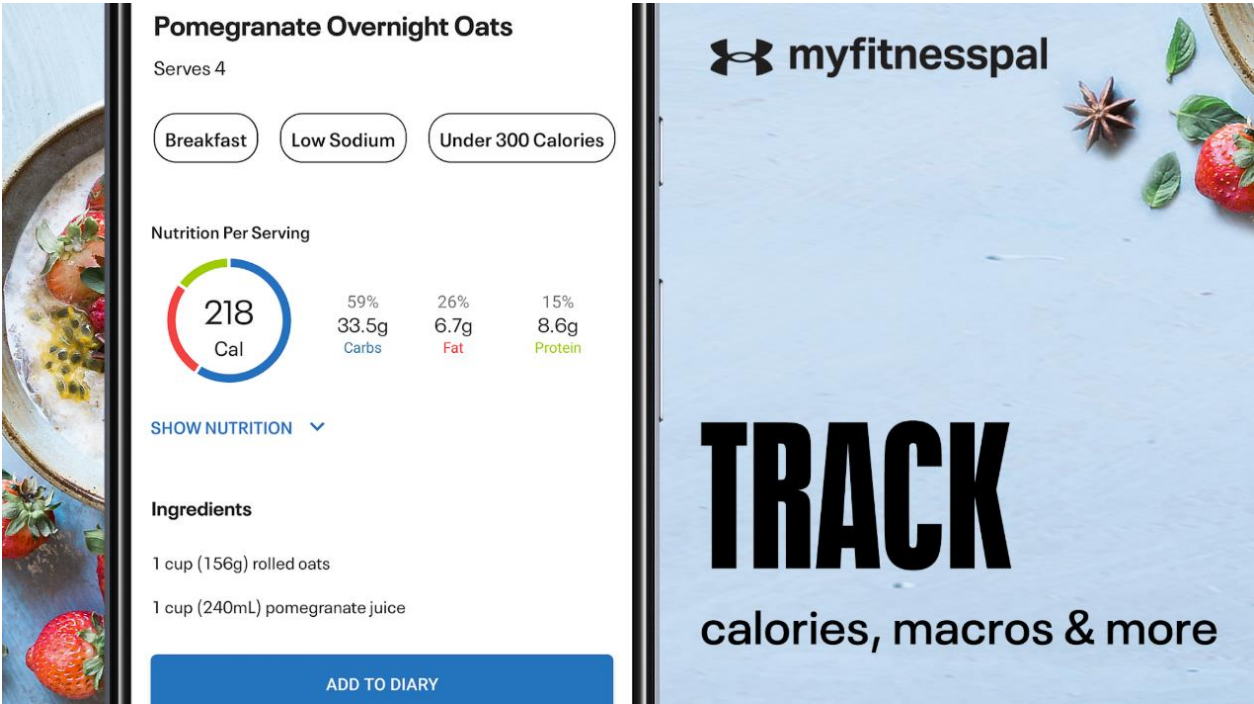


Figure 9 shows the appearance for MyFitnessPal (MyFitnessPal, 2020)

4.4.2. Overview

MyFitnessPal is an application that lets users explore the options of food tracking. MyFitnessPal can log meals, as quickly and easily as possible. Over 200M pounds and 88% of people who track their foods for at least 7 days lose weight (MyFitnessPal, 2020). Many different features to explore as well as logging foods; users have an option to track food, reach goals and log exercise. Please refer to Appendix B in Chapter 12 where you can explore different features in greater details.

4.4.3. Assessment

Please refer yourself to Table 7 where this shows areas of assessment for this application. You may notice that this application has been rated among the highest and with the most downloads out of the three applications that have been assessed.

Table 7 shows the evaluation for MyFitnessPal

Areas of Assessment	Rating out of 10
Features	6
Guidance	5
Usability	8
User Interface	6
Ease of Use	6
Consistency	7
Google Review Rating	4.5
Downloads	50M+

#### 4.5. Conclusion

As you may notice, all three applications that have been named are all different. They all represent a piece of the final product. Therefore, you may notice the uniqueness of this project as having surfed through on Google Play Store, no application with the use of NFC tags could be found.

MyFitnessPal is an application that has limited features that have deep exploration of nutritional values. Many users have rated this application as the best out of the three that have been mentioned. Therefore, the template of this should be followed to set an example of this current project set. Another point that can be compared is that CalorieCounter had more features to explore.

Change4Life have limited features that are comparing to the other applications that have been mentioned. Although this is the case, the limited features that were displayed, it showed the necessary information and used impressive user interface of the way the assessment has been displayed. This can be an example that can be used exactly the way that is intended by using NFC. This would be one of the positives for Change4Life that can be taken from.

CalorieCounter is one of the applications that have both above that have been mentioned. A consistency with brand, colours, usability that this application uses. Although positives that can be taken into consideration, if this application all-rounded would be the best. It demonstrates great consistency, brand, features and has the best assessment shown out of all three of the applications demonstrated.

#### 4.6. Key issues to address in the design and implementation

- Application must make sure to have a breath of features for users to be satisfied e.g. calorie count, graphs, figures, history of scanned product.
- Application can consider some of the features that have been highlighted across all three of these applications.
- Application must make sure to have consistency with brand colours, as shown by CalorieCounter
- Application must be easy to find and some form of guidance for new users to explore features such as CalorieCounter
- Application must ensure and consider research that has been answered by 46 students about different questions. You can find more information in Chapter 3 and 12 for further information.
- Users have expressed the desire of having history of items scanned with 97% of responses stating they wish to have this feature
- 31 out of 46 responses state that they do not regularly check the nutritional information at the back of a product before they eat it. A key area to address would be and make sure that informative information correctly and ensure that the students have been benefited from this.



## Chapter 5: Legal, Social, Ethical, and Professional issues

This final year project would be aimed for University of Greenwich students to encourage nutritional values. General Data Protection Act was adopted in April 2016 for those who violate its privacy and security standards. These standards that GDPR acts upon privacy laws across all countries. GDPR legislates businesses of how data is handled across any organisations. There is a potential huge fine for potential breaches across any of GDPR laws (Burgess, 2020).

Referring to Appendix C, Georgios Samakovitis, our School Ethics representative has confirmed that the Research Ethical approval is not needed as all the questionnaire that has been sent across does not collect any personal data nor involving externals. To avoid GDPR, all information that has been collected will ignore any personal data that has been sent across as Google Forms does this for you. Please refer to Appendix A where you can find the link and questions to all the questions mentioned. All students would need to be eighteen or above as any less or external users would need to acquire approval of Research Ethical. As stated, this would not be necessary. All questions that are going to be used would prevent any necessary personal information. Therefore, this would prevent any GDPR laws to be breached.

As well as personal data, all GDPR laws including project would need to be followed. As this is a prototype, and it should not follow nor copyright any content. All content that it shall use would be referenced in Chapter 11 for further details on this when stated. As this involves users, some form of profile would be used for each user. All content needs to be sorted and made sure that all content is equal for all users to view. This follows up on social issues that may arise as many different users register for the system speaking different languages, race, and background. Therefore, this will become clearer within Chapter 6, however, it would be ideal for users to have different languages.

Developing this android application, a professional manner would need to be followed by the guidelines of BCS and IEEE standards. One of the BCS standards that stems from the Chartered IT Professional Standard would be to follow “*undertake to maintain and develop their knowledge and skills in the IT profession by keeping a record of professional development*” (BCS, 2020). IEEE standards follows the same procedure by develops, defines, and reviews electronical standards.

An example of this would be Luckin Coffee inflated sales and ended up with \$300 million fraud on its accounting books. Nasdaq ultimately delisted the start-up company because of fraudulent activity. Smaller companies need to make sure that these results are accurate to progress (Leonard, 2020). Ethical issues can face numerous areas in a business. Therefore, it is a best practice to address and resolve the situation as accurate and fast as possible.

Ethical issues would show privacy concerns that need to be considered and reviewed when dealing with personal data. GDPR issues have already been stated. However, username and password that needs to be entered needs to be encrypted to prevent further security risks for any personal information being stored. To be clear with your user community, you would need to create privacy policy to let users know what type of data is being stored and the reasons behind this. Therefore, it would not cause any further confusion or issues. To improve technology, you first need to understand the consequences it faces.

## Chapter 6: Requirement Analysis

### 6.1. Introduction

To proceed to the next stage of this cycle, the process of gathering and analysing the requirements that are necessary for this project will be mentioned. This analysis will be using previous chapters to analyse the requirements stated. A questionnaire was sent out to current University of Greenwich students conducting series of questions about this project. Please refer yourself over to Chapter 3 and Appendix A for further information about what was asked, and the results of this.

Besides, similar existing products that are on the market for this project. However, as stated in Chapter 4, it was difficult to find a product on the market that represents this idea, hence the uniqueness. You can see the different types of styles that were found to get a better idea of how to structure and design the upcoming product. Therefore, all of this research that has been found within Chapter 4 will be used for analysis on requirements.

Further to this, a literature review was conducted within Chapter 2 where this displays different topics supported by academics for further background research on topics of NFC, and barcode. Besides, Chapter 5 discusses further analysis on any issues for LSEP too.

You may notice that all this research has been conducted to support and gather requirements as best as possible. All this research has been in preparation to conduct and analysis on requirements that are going to be mentioned. A key factor to look out for would be the issues to address stated within each section.

### 6.2. Target Audience

The target audience for this project would be aimed at students, staff, and alumni of University of Greenwich. However, for further demand, it can be developed further to suit adults, children, and all backgrounds within the UK. Another aim would be to ensure that this product would suit background of all races, and gender. Therefore, it can prevent any further issues developing within the future.

### 6.3. Statement of Requirements

Statement of Requirements require two: functional and non-functional requirements. Functional Requirements (FR) describes what a system should be able to do and Non-Functional Requirements (NFR) constraints on how the system should be able to do this. Each requirement that is named within these two requirements are going to be using MoSCoW as stated in further detail within Chapter 1. Requirements should be named as prioritised order. 'MUST' and 'SHOULD' are the requirements that are priority and implemented. 'COULD' and 'WONT' are the second priority requirements where it could be listed as it would be a bonus. All of these requirements would be named and stated alongside MoSCoW techniques as to whether it would be possible given the research that has been concluded above.



#### 6.4. Functional Requirements

Functional Requirements	Description	MoSCoW
1.	Users should be able to view nutritional information for products by using API	MUST
2.	Users should be able to search through all the available products using API	MUST
3.	Users should be able to write nutritional information using API to NFC tag	MUST
4.	Users should be able to overwrite nutritional information using API to NFC tag	
5.	Users should be able to read information that has been written to NFC tag	MUST
6.	Users should be able to view assessment on the nutritional NFC tag using 5 stars	MUST
7.	Users should be able to track and calculate calories using products search	MUST
8.	Users should be able to set a goal of calories they wish to achieve	MUST
9.	Users should be able to reset their calorie count as they wish	MUST
10.	Users should be able to add their calorie count by the end of each day to their diary	SHOULD
11.	Users should be able to track the list of scanned items i.e. history	SHOULD
12.	Users should be able to clear the history if necessary	SHOULD
13.	Users should view their profile to access	SHOULD
14.	Users should be able to update their profile	SHOULD
15.	Users should be able to create their account to register for the application	SHOULD
16.	Users should be able to login to the application	SHOULD
17.	Users should be able to save database using Firebase	SHOULD
18.	Users should have administrative mode where writing to tag only allows admin to do so	SHOULD
19.	Users should have a secure pin where administrators are allowed to access pin in the settings	SHOULD
20.	Users should have a settings tag where users can access different features	SHOULD
21.	Any validation should be inserted throughout the application	SHOULD
22.	Any major errors should be aimed to be prevented throughout the application	SHOULD
23.	All information within the settings should be stored within the storage	COULD
24.	Users should be notified of the information use for Nutritionix API	COULD
25.	Users should be able to navigate freely throughout the application	COULD
26.	Users should be able to share the application across to other users	COULD
27.	Users should be able to have a contact feature where suggestions and improvements could be made	COULD
28.	Users should have a flexibility for different languages to occur e.g. French	COULD
29.	Users should be able to have a logout system too.	COULD
30.	Users should be able to have a guidance system where new users are told what to do and where to go	WONT
31.	Use different techniques to prevent hacks and threats e.g. SQL Injection	WONT

## 6.5. Non-Functional Requirements

Non-Functional Requirements	Description	MoSCoW
1.	Usability – The application must be clear and easy to understand. Any interaction that the user comes across using the application, it should be usable and clear to understand.	MUST
2.	Confidentiality – The application must protect sensitive and personal data. This must only allow administrators and authorised users to use sensitive data.	MUST
3.	Easy to understand – Any application must be easy to understand. Different users understand written text differently. Therefore, it should cater to all users.	MUST
4.	Security – Data should try to prevent unauthorised data to be accessed. SQL Injection is a classic example of where simply users can access unauthorised data.	MUST
5.	Accessible – The application should cater to all different types of users. For example, different language change e.g. French. Any person should be able to use the application.	SHOULD
6.	Performance – The application should run smoothly without any bugs or errors. In terms of crashes, it should be sorted as soon as possible.	SHOULD

## 6.6. Conclusion

These are all of the requirements that are necessary for the design and implementation stage. As briefly mentioned previously, all requirements that have been used have been gathered using previous research suggested within previous sections. All of the requirements that have MoSCoW as MUST and SHOULD be met. The conditional requirements would be COULD and WONT. These are the requirements that are not necessary to complete. Any requirements that are not going to be complete, it will be mentioned the reasons behind excluding this. However, further information will be provided within the later sections.

## Chapter 7: Design Development

### 7.1. Introduction

After reviewing all of the existing, primary and product research, a visual representation will be used to clarify ideas of how the existing nutritional application would be visualised. These diagrams would

include Entity Relationship Diagram; Use-Case Diagrams; Wireframes; Class Diagram, Sequence Diagram and Sitemap Diagram.

7.2. Use-Case Diagram

Primary Actor: User

Secondary Actor: Admin

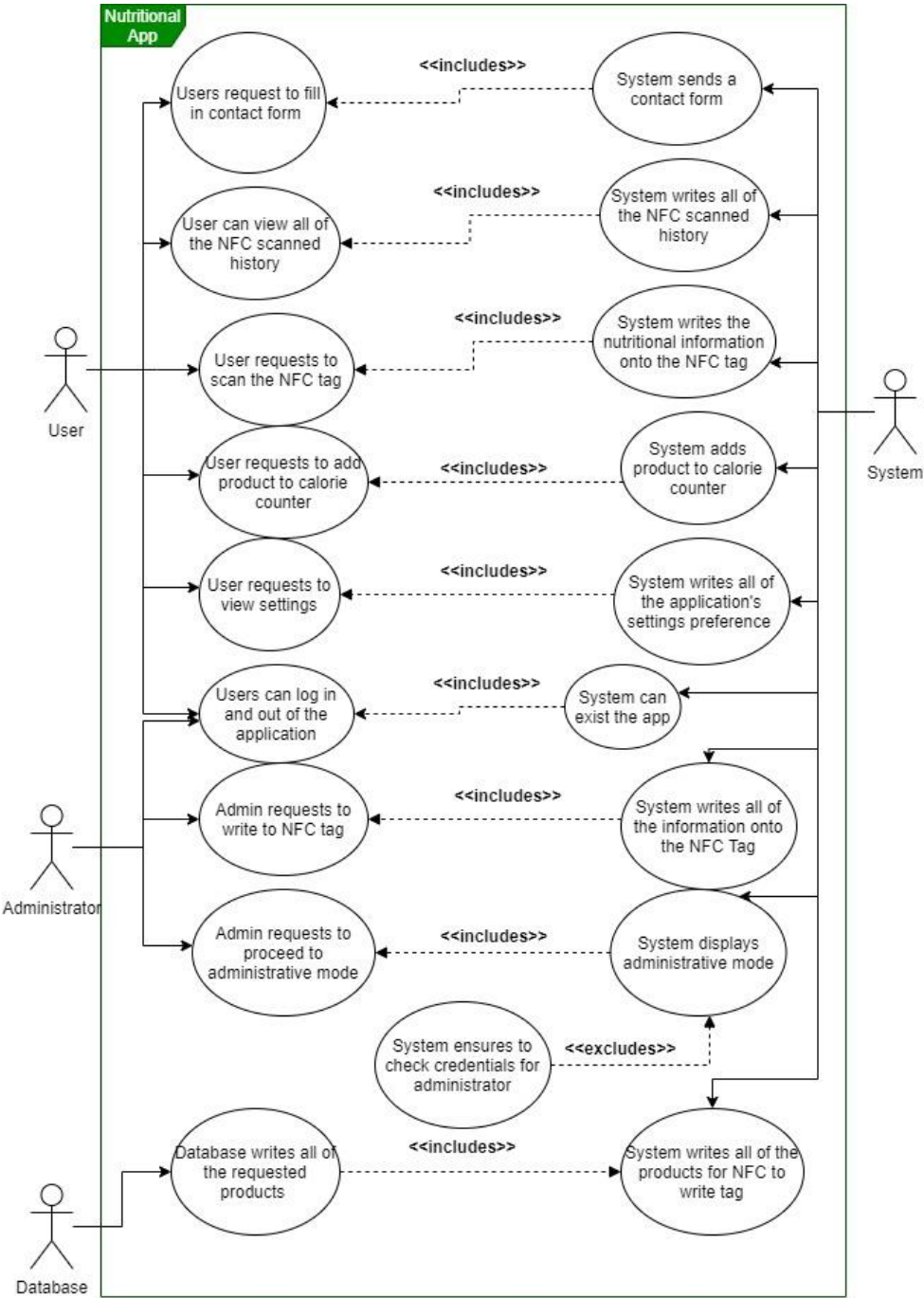


Figure 10 shows the use-case diagram with different actors

Referring to Figure 10, the Use-Case Diagram shows the actions of both primary and secondary actors. This shows how all of the interaction of users within the system interact with each other. The difference between the two main actors would be the administrator can have access to writing and updating tag information. Administrator access would only be enabled if the credentials that have been set matches,

otherwise it would not be enabled. Administrator may also browse to scan NFC tags, calorie count, view history and settings. All of these features are exactly like users. However, the difference can write and update NFC tags.

Administrator would be the secondary actor as this user would be able to write and scan tags. Therefore, this would enable users to scan and view the information of NFC tags. This plays an important part of this diagram of the whole diagram. As mentioned, the primary actor, users, would be able count calories, view history, scan NFC tags, and view settings of application.

Database actor would be the interaction of using the Nutritionix API that can view all of the products for administrators to use. Therefore, this is important that to mention the API interaction that will be used within the system too. This also includes the interaction of inserting, updating information of using Firebase too. Therefore, it was important to generalise this further.

### 7.3. Wireframes

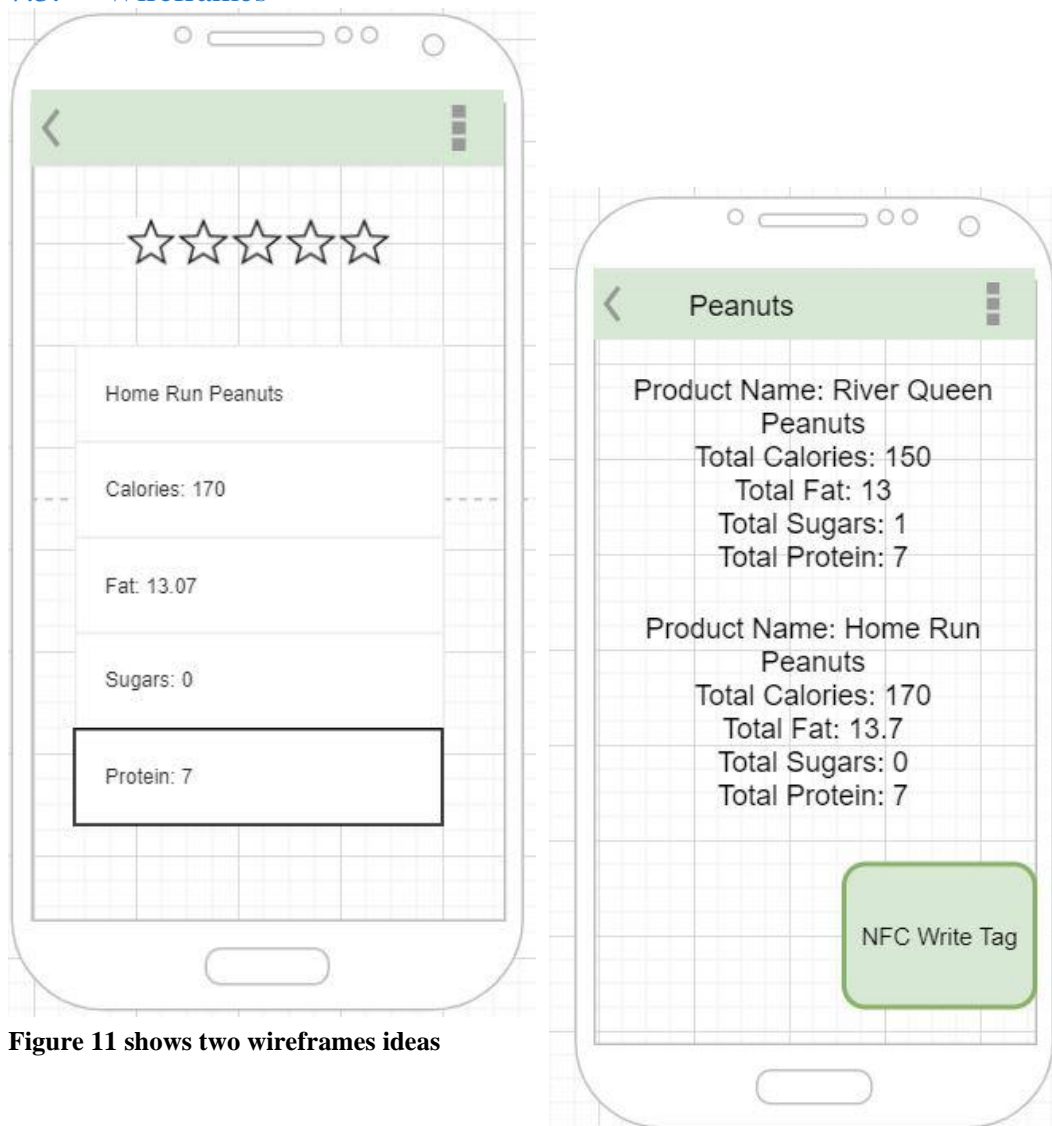


Figure 11 shows two wireframes ideas



**Figure 12 shows two wireframe ideas**

Referring to Figure 11 and Figure 12, it shows and demonstrates the four different wireframe ideas that OI have come across having using all of the research that have been mentioned. Figure 11, left picture, shows an assessment of how a product would show once the NFC tag has been scanned. As you can see, it shows in detail each of the nutritional values that have been stated and it gives a rating of what is thought about the product being scanned. Figure 11, right picture, shows a wireframe where an administrator can search for products using the API library. Once a product has been selected, it would demonstrate to write it to the tag once it has been scanned through the phone. Figure 12, left picture, shows where users can calculate their goal by entering the product that they would like to add. You can also see an option to reset option that sets the goal to 0 for the user. Figure 12, right picture, shows the main display where both actors can read the tag. Please note that these wireframes are not the exact image of the final product. Figure 11 and Figure 12 are both rough images that can be finalised to the final product. However, this may change dependant on later improvement and testing.

## 7.4. Sequence Diagram

### 7.4.1. Writing NFC Tag

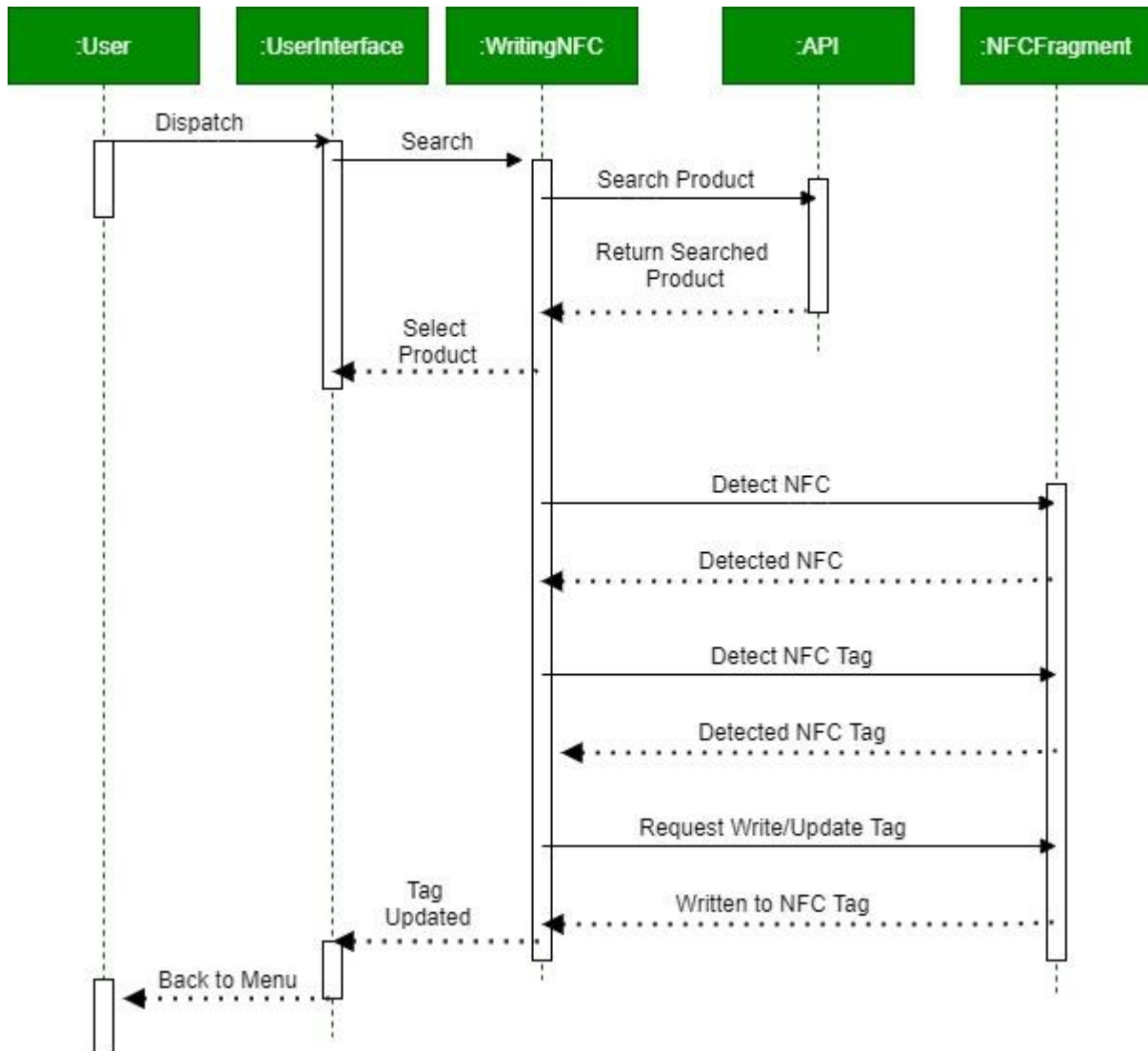


Figure 13 shows a sequence diagram for writing NFC tag

#### 7.4.2. Calorie Count

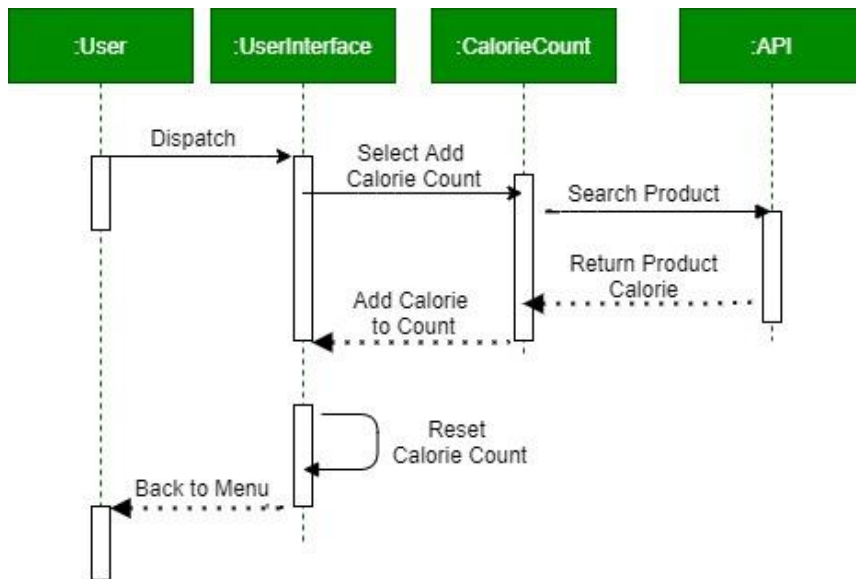


Figure 14 shows a sequence diagram for calorie count

#### 7.4.3. Reading NFC Tag

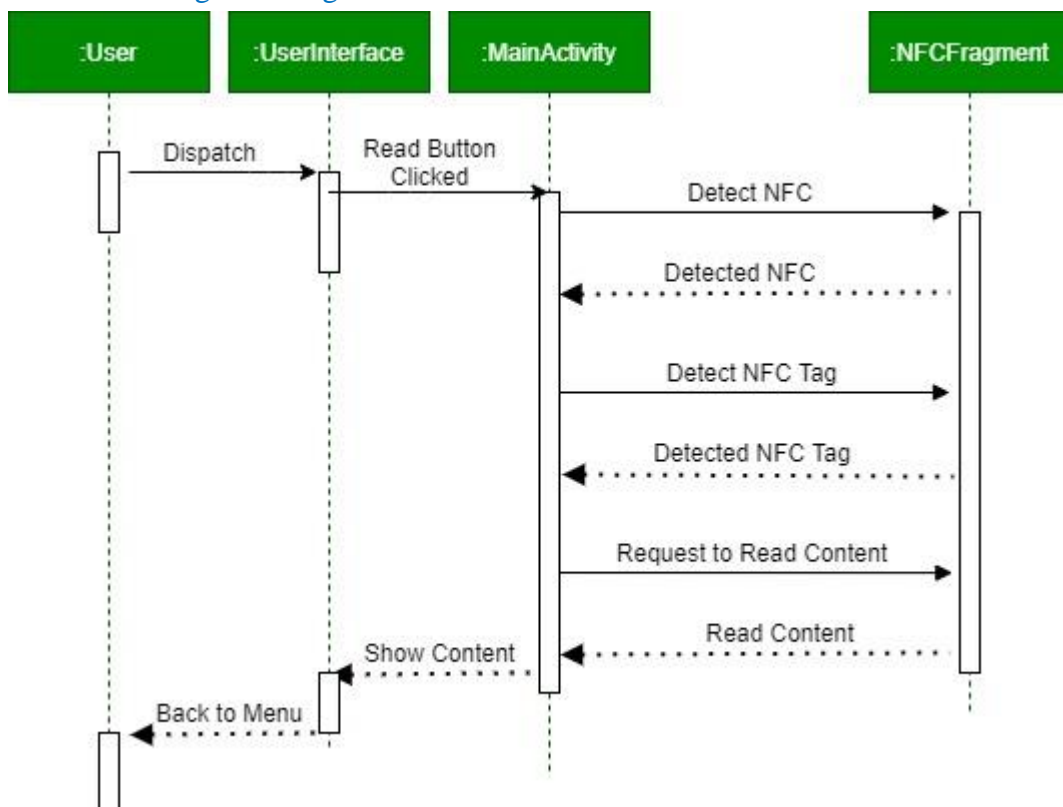


Figure 15 shows a sequence diagram for reading NFC tag





## 7.5. Class Diagram

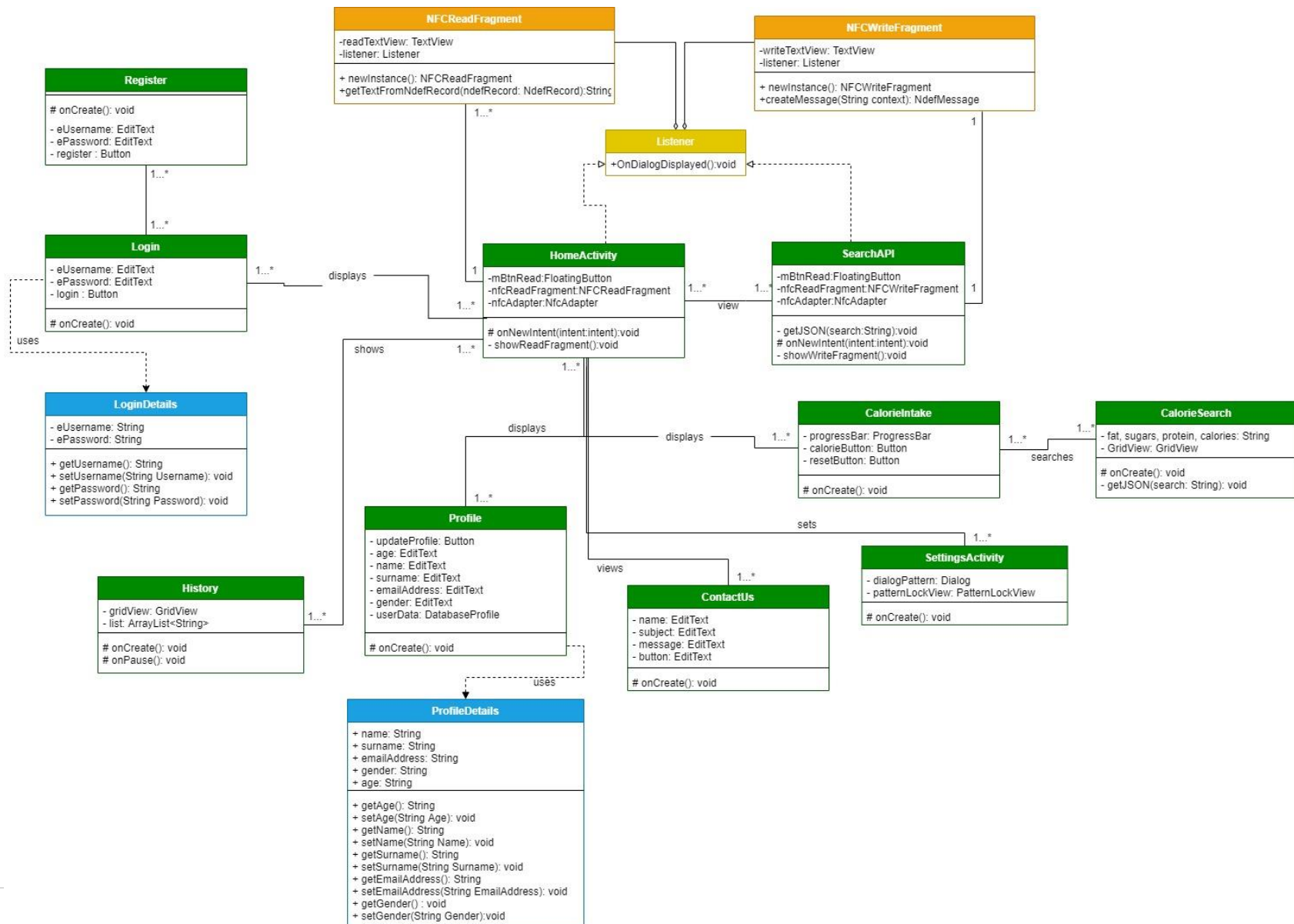


Figure 16 shows the class diagram for this project.



## 7.6. Site-Map Diagram

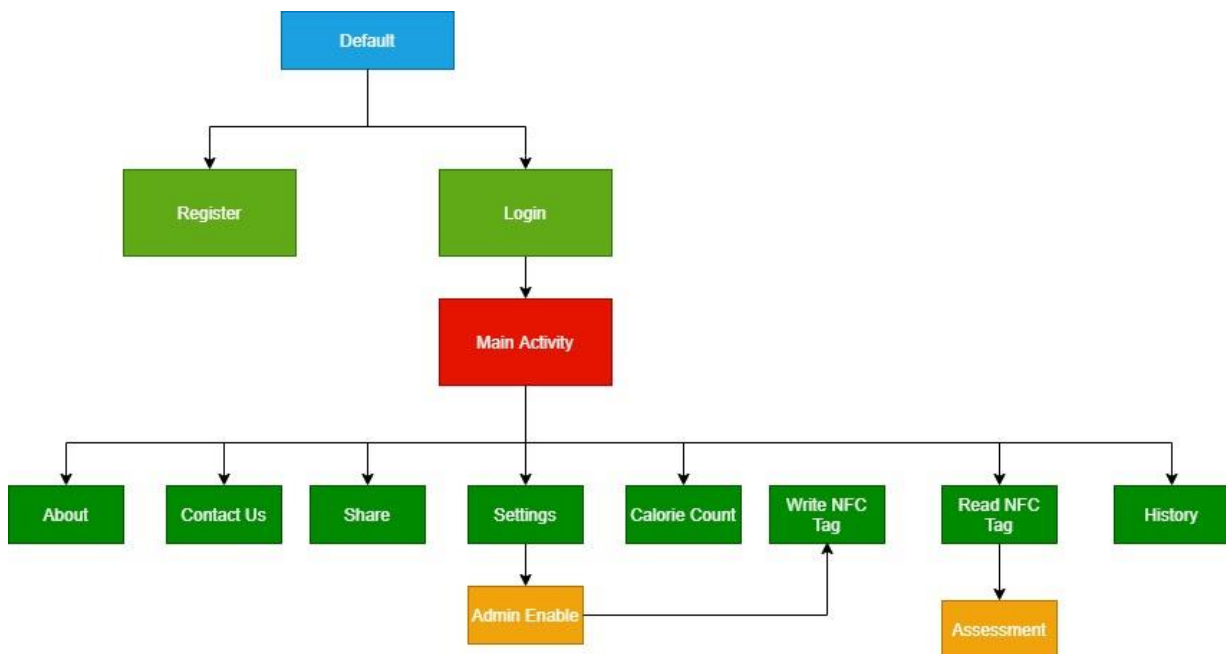


Figure 17 shows a site-map diagram of the project

A site-map diagram would show a flow of connections between web pages as a 2D representation. This allows developers to plan efficiently with a bird's eye on the whole project. Therefore, it shows a better and clearer representation of the entire project. Referring to Figure 17, this shows the layout of the different classes that are going to be used within each of the entire project.

As you may notice, a series of diagrams have been mentioned to make a clearer understanding of the system.

## 7.7. Entity Relationship Diagram (ERD)

Entity Relationship Diagrams are an important aspect because it provides logical structure of the database. It is an effective tool for a designer database. Referring to Figure 18, this shows the ERD relationships between two databases that are going to be used between each other. This demonstrates the entities, relationships and attributes that are going to be used for the database within this project. As you may notice, not much of this information was stored. Most of the data that was used were temporary data within the database. However, these two are the most important aspect as the rest of the information is stored differently.

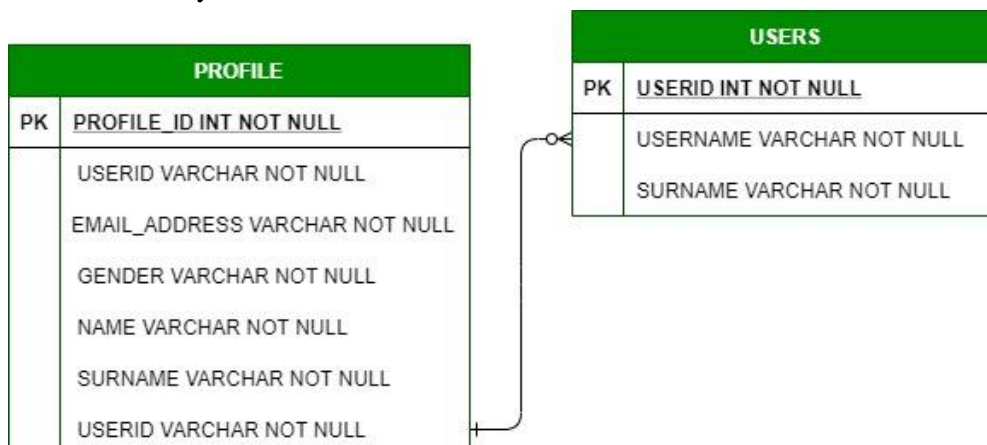


Figure 18 shows the ERD diagram relationship

## Chapter 8: Implementation

### 8.1. Introduction

This section is to intend to discuss the process of forming the final version of the prototype. This prototype has been named as Healthy Tag. This was important to make sure that this prototype has a name to reference it back towards too. Referring to the wireframes sketches was a beginning of starting the design process of Healthy Tag. However, a more dedicated research, reading, investigating, and applying new knowledge to this project was a challenge too. Healthy Tag was developed using Android Studio with Java, Firebase with RESTful API using Nutritionix.

### 8.2. Process of Implementation

Thanks to the Wireframe sketches that initially had been drawn by hand and transferred over electronically, this paved a new way of structuring the diagrams into navigation layout. Android Studio introduces users to many different layouts that the users can explore having using the diagrams as a basis. Once further research was conducted as to what layout was used, a responsive layout was used to ensure that different sizes of Android screens it would be adaptable. Ensuring that all of the design and layout met the needs of the wireframes, it gave a basis to ensure that Healthy Tag and its green brand would be represented on each of the layout that has been mentioned. This enables the consistency, and simplicity throughout the project.

The first process would be to initialise the database that was going to be used. A variety of options came into mind using SQLite. However, the process of managing SQLite would be weak and needed a stronger background of a database. Having completed more research, Firebase is a cloud-hosted database that shows real-time database. Firebase is Google's mobile application platform that lets users build, improve and grow applications. Therefore, this allowed Healthy Tag to express the use of using a database on a better platform. Making sure that the database is communicating is essential of Healthy Tag and Firebase. Real-time Database is a system, a type that Firebase uses, to enable real-time processing to develop and work on applications offline too. Referring to Figure 18, it demonstrates two tables that consist of using both throughout the application. Moreover, throughout all of the projects that have been handled, a good approach would be to central all of the database through one class. Therefore, it would prevent duplication and good practice. However, as this application would only store the profile and login details for users, this practice would only be used if the database would be predominantly used. Therefore, as well as this practice has been used for previous projects, this would be well left out throughout this project.

Major changes were made throughout the application itself. Therefore, I will be discussing in stages of prototype of the various changes that were made throughout this implementation stage. Prototype A was the focus of implementing RESTful API. A RESTful API is where two softwares communicate with each other using GET, PUT, POST or DELETE data. Main discussion throughout this research was to use Nutritionix. Nutritionix provides a limited service for free users, in terms of users, and queries sent. However, this was all that is needed to showcase the potential use of Nutritionix API use even if the possibility of discussing this further for a potential fee. The main aim of this stage of the prototype was to enable the search of different products. When testing the API through the application, it came across to myself that the main issue when testing this was following in the results came from this. A different way to test the API to ensure that it was correctly working each time, it would be to test the URL. It would result in different making sure that the correct answer is correct when testing within the URL. This method was completed several times until this was satisfied that the issue was not stated within the URL. Therefore, this was an easier way to ensure that the right search was conducted. Prototype A also included search filters enabling users to filter through numerous calories that they can choose which product they would like to surface. Please note that all Prototypes that are going to be mentioned are going to be made clearer within the Appendix. Therefore, please ensure you reference over to the Appendix D for further information.

Moving on to Prototype B, it became clear that the NFC had to be integrated once the API was completed and tested. To progress with NFC, it became clear to purchase NFC Tags. Therefore, *10 NFC Tags with 144 Bytes Memory* was ordered from *Amazon* to progress and proceed with the application. Whilst this was in transit, research began to start to proceed in ways to progress to write and read NFC tags. Whilst researching on NFC, a book from Vitor Subtil called *Near Field Communication with Android Cookbook* was published. This introduces numerous possibilities of NFC including reading and writing through a tag. Therefore, this gave myself a basis of which libraries to look out for. Therefore, once I was able to navigate through using NFC, the main issue when trying to integrate API with NFC was the use of using fragments. The issue became clear when trying to put the two together. This will be discussed further within the technical issues. However, having solved some of the NFC issues, it became clear that the NFC was integrated. The process of integrating it was first to ensure that the read and write tag works on two different classes. It was a challenge to work on it separately. However, once this was ensured that it worked separately. A challenge was to integrate this within the main classes.

After the integration of NFC, I had to ensure that added onto Prototype B would be the need some form of assessment when scanning the NFC tag. Therefore, as research in Chapter 2 and Figure 11 shows that this was exactly the case. Figure 11 demonstrates exactly the form that has been integrated within the final product. Just to clarify, the NFC read assessment would integrate with a rating out of 5 and include the 4 nutritional values that have been selected to write within the tag. Therefore, it would show the layout exactly how it has been shown within Figure 11, left picture. This shows that the wireframes and research that have been discussed have been a massive assistance when implementing this final prototype.

Prototype B also included a calorie feature where this explores the option of calorie counter. As stated, reading the NFC tag would be one of the features. However, this was an option for users to count their calories. One feature that has been included from Figure 12 would be to add an option for users to include within their diary how many calories that they have had throughout the day. Therefore, a user can explore the option to add calories and keep in track how many calories that they have ate throughout the week. A different, but valuable option as explored within the existing product research that was conducted within Chapter 4. A feature was also including within the settings as the user can adjust within the calorie settings. Therefore, if the user wishes to have 2000 calories. They can adjust this as a goal set.

Prototype C would be adding numerous features to the final touches of the application. Prototype C would include adding features that are necessary within this application. Therefore, a setting has been integrated enabling only administrators to writing tags. However, this can only happen if they pass through with the right credentials i.e. the correct pattern. A numerous feature that have been included within several different projects that are mandatory for myself would be adding a contact feature, sharing the application and informing what this application is about too. A last feature that Prototype C would be included would be to add another language to the application. In terms of usability, it would cater for French and English only. However, a further improvement would be looking to add more languages to cater to different backgrounds if the device has different language set. Please note that the final Prototype shows additional screenshots and explanation with Appendix D for Chapter 12. Therefore, if you wish for further information, you can refer to this for further information.

### 8.3. Technical issues

As stated, many different challenges came across implementing this. As briefly discussed previously, a challenge of integration of NFC. It was a challenge to do. A consistent error that I kept receiving was the fact that when integrating this was when using the NFC. I had to integrate this within another class. Therefore, I had to separate it and it was causing a challenge. An error kept appearing when on occasions, the button didn't work, the NFC didn't appear to work, the NFC Fragment causing errors off the application. Therefore, a deep analysis on this later issued and found the errors that was causing these issues within the first place. Many different stages had different errors. However, this was one of the issues that caused the most. However, as it was a challenge, it was interesting to know that soon enough the NFC worked.

### 8.4. Architecture Diagram

Referring to Figure 19, this demonstrates the architecture of the whole system. This shows the various external communications that the system must go through the application server.

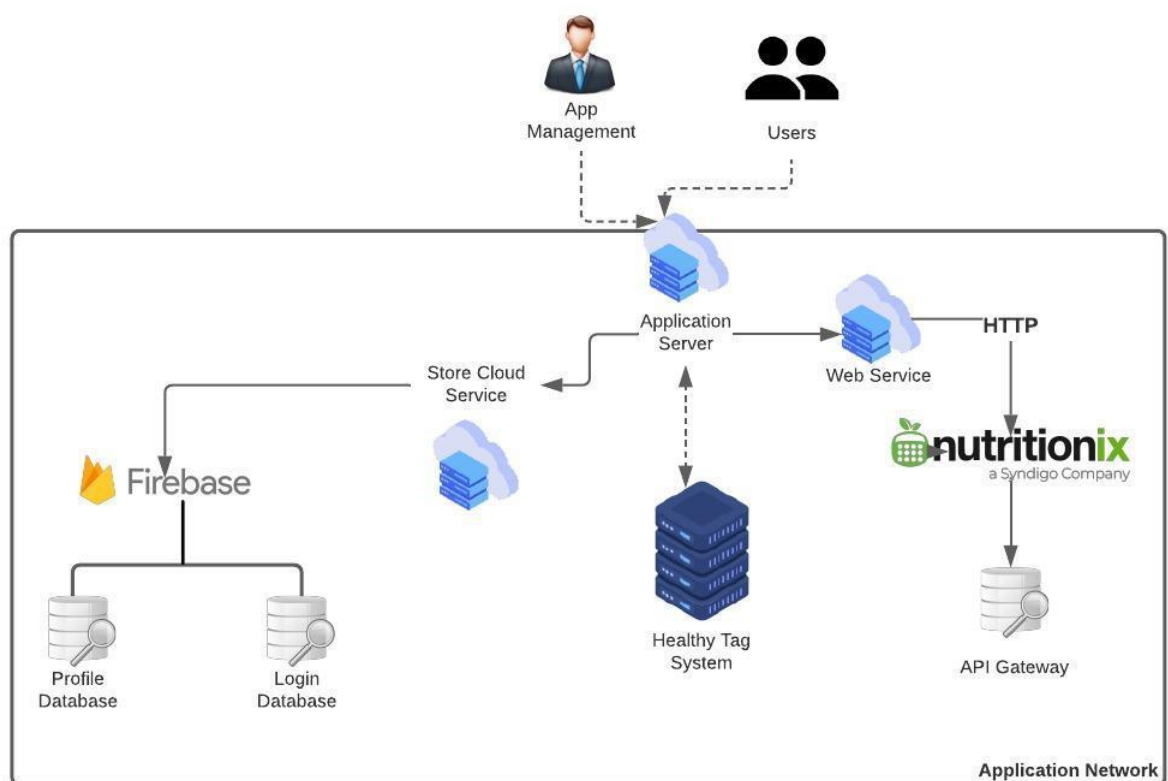


Figure 19 shows the architecture diagram of the whole system

## Chapter 9: Testing

### 9.1. Introduction

Integration Testing is only showing the internal structure to show that it is working e.g. is the button working. However, the unit testing shows the analysis on functionality. Hence, the reason why both of these were selected. User Testing would be the process of expressing the functionality of a real user. All of these tests are to show that each functionality that has been shown are working.

### 9.2. Integration Testing

**Table 8 shows numerous tests for White Box Testing**

Test No.	Description	Expected Results	Actual Result (YES/NO)
1.	Running the Android Studio application	Expecting the application to run and display the main page	YES
2.	Registering for the application	Ensuring the application can register for the application	YES
3.	Logging into the application	Ensuring the application can log in to the application with the registered details.	YES
4.	Logging out of the application	Ensuring the application can log out of the application.	YES
5.	Reading NFC tag	Ensuring the NFC tag has been scanned and readable to show a result	YES
6.	Admin can enable administrator mode	Ensuring the administrator mode has been enabled with the correct credentials	YES
7.	Writing NFC tag	Ensuring the admin can write/update to an NFC tag	YES
8.	Calories Count	Ensuring users can add calories to the goal set	YES
9.	History	Ensuring users can view the history after scanning NFC tags	YES
10.	Contact us	Ensuring that the users can send emails to developers for any further concerns they have.	YES
11.	Share	Ensuring that the users can send a link of the APK to download and share the application	YES

### 9.3. Unit Testing

Test No.	Description	Code	Expected Results	Actual Result (YES/NO)
1.	Can the database update the information registered?	<pre>userdata = snapshot.child("profile") .child(userid) .getValue(DatabaseProfile.class);</pre>	Expecting the information set to update within the Firebase database.	YES – updated information for profile and register
2.	Can the admin login with incorrect credentials?	<pre>patternLockView .setViewModel(PatternLockView .PatternViewModel.WRONG); switchPref.setChecked(false);</pre>	Expecting the Pattern to disable the admin mode if incorrect	YES – if administrator forgets passcode, he should use the contact form to inform developer
3.	Can the device detect the NFC it is enabled?	<pre>nfcAdapter = NfcAdapter.getDefaultAdapter(this);</pre>	Expecting the NFC to be detected once it is enabled.	YES – works once NFC is enabled
4.	Can the device detect the NFC tag?	<pre>Tag tag = intent.getParcelableExtra (NfcAdapter.EXTRA_TAG);</pre>	Expecting the NFC tag to be detected	YES – detects NFC tag and shows a message of this
5.	Can the settings be saved once device is offline?	<pre>SharedPreferences pref = PreferenceManager. getDefaultSharedPreferences (getApplicationContext());</pre>	Expecting the device to save the settings that are set.	YES – saves the data
6.	Can the settings be saved once it has been altered?	<pre>&lt;EditTextPreference     android:defaultValue="0"     android:dialogMessage="@string/enterGoal"     android:inputType="number"     android:key="calorie_current"     android:selectAllOnFocus="true"     android:singleLine="true"     android:title="@string/calorieIntake" /&gt;</pre>	Expecting the settings to be saved once altered.	YES – updates the settings data too
7.	Can the history be inserted once scanned?	<pre>final String value = sp.getString("users", ""); list.add(value);</pre>	Expecting the history of scanned tags to be inserted	YES – however, turn to another page, the history is cleared.



8.	Does the options of application s appear for users to select?	<pre> Intent calendarIntent = new Intent(Intent.ACTION_EDIT); calendarIntent.setType ("vnd.android.cursor.item/event"); //gets Google Calendar calendarIntent.putExtra ("allDay", false); //how long calendarIntent.putExtra ("description", "by: Healthy Tag Application"); //description </pre>	Expecting the options to show for expected buttons	YES – right applications appear for sharing, contact us, adding to diary
----	---	---	--	--

**Table 9 shows numerous tests for Black Box Testing**

## 9.4. User Testing

**Table 10 shows the process for User Testing**

<b>Author:</b> Usman Basharat	<b>Contact Details:</b> ub2232e@greenwich.ac.uk		<b>Date:</b> 13 <sup>th</sup> September 2020	
<b>Product Under Test:</b> Healthy Tag – Android Application	<b>Test Objectives:</b> Running the application and ensuring this works. Any feedback will be notified.	<b>Participants:</b> 2	<b>Test Tasks:</b> Run all parts of the application Score out of 10 Feedback for further improvement	<b>Responsibilities:</b> Usman Basharat (Developer)
<b>Business Case:</b> Further improvements on application		<b>Equipment:</b> Android, NFC		<b>Date Test Taken:</b> 13 <sup>th</sup> September 2020
<b>What are the main steps in the test procedure?</b> 0 to 5 – reading 5 to 10 – preparation for tests 10 to 30 – running tests 30 to 40 – feedback				

### 9.4.1. User Testing Case 1

**Table 11 shows numerous tests for user testing 1**

Test No.	Description	Result	Rating (out of 5)	Further Improvement Feedback
1.	Running the Android Studio application	YES – it ran smoothly	5	No Comment
2.	Registering for the application	YES – it registered the details	4	What if I forget my password?
3.	Logging into the application	YES – able to login through the registered details	5	No Comment
4.	Logging out of the application	YES – able to logout of the application too	5	No Comment
5.	Reading NFC tag	YES – able to read NFC tag	5	No Comment
6.	Admin can enable administrator mode	YES – able to enable admin mode	5	No Comment

7.	Writing NFC tag	YES – able to write and update over NFC tag	5	No Comment
8.	Calories Count	YES – able to count and reset calorie count	5	No Comment
9.	History	YES – able to view the history of scanned NFC tag	4	No Comment
10.	Contact us	YES – able to redirect to outlook for an email	4	Should be able to send the email via the application
11.	Share	YES- able to share application via WhatsApp	4	Put this on Google Play Store?

#### 9.4.2. User Testing Case 2

**Table 12 shows numerous tests for user test case 2**

Test No.	Description	Result	Rating (/5)	Further Improvement Feedback
1.	Running the Android Studio application	YES – it ran smoothly	5	No Comment
2.	Registering for the application	YES – it registered the details	4	A bit slow.
3.	Logging into the application	YES – able to login through the registered details	4	Checking credentials slow. Once completed more than once, it was faster
4.	Logging out of the application	YES – able to logout of the application too	4	No Comment
5.	Reading NFC tag	YES – able to read NFC tag	4	Should notify users to enable NFC
6.	Admin can enable administrator mode	YES – able to enable admin mode	4	No Comment
7.	Writing NFC tag	YES – able to write and update over NFC tag	5	Should notify users to enable NFC
8.	Calories Count	YES – able to count and reset calorie count	5	No Comment
9.	History	YES – able to view the history of scanned NFC tag	4	No Comment
10.	Contact us	YES – able to redirect to outlook for an email	4	Should be able to send the email via the application
11.	Share	YES- able to share application via WhatsApp	4	Put this on Google Play Store?

## 9.5. Changes made to Prototype C

Simplifying testing is easier for using both integration and unit testing. By testing parts of the application via unit testing, it would make it easier to test the accuracy of the process. Please ensure that user testing would be a further feedback of what users would assume of the product. Rating has been given to give further feedback on this too.

As you may notice within the testing, further feedback was provided to ensure that last changes are made to Prototype C. A fix that was noticed to ensure that users would enable there NFC upon using the application. Previously, it was noticed that users would not be informed of this decision. Therefore, there was a lack of clarify of this as users would tend to get confused. Another would be forgotten passwords. There are many applications which use different skills to save the passwords that can be included. As the login details are not mandatory, users can create another account and get in contact with the developer through contact us for further information on this. However, this can be one of the approaches and improvements for this application. Further feedback is provided within Chapter 10 for this improvement. A small issue that can be viewed as an improvement would be to reflect application on Google Play Store. At this very moment, it would be a prototype. Therefore, publishing an application right at this moment would not be the case as professional developers can enhance this application further. This would be the same case for sending an email through contact us. This can be a personal preference. However, further feedback can alter this suggestion and keep this idea within the first place.

Please note that the final Prototype shows additional screenshots and explanation with Appendix D for Chapter 12. Therefore, if you wish for further information, you can refer to this for further information.

### 9.5.1. Feedback from Demonstration

Positive feedback was offered to enhance further issues with the product and report. Suggestions to improve would be to offer daily resets for calorie counters for users. This ensures that the calorie count updates daily. Another suggestion that was offered by Markus and Elena would be to ensure the servings can be adjusted. This can ensure that users can adjust food intake if the whole meal has not been finished. Further improvements were ensured to adjust within the report that will be noted and evaluated within Chapter 10 for further details.

## Chapter 10: Evaluation

### 10.1. Introduction

Evaluation is a key element within any process of any project. Therefore, within this section, different evaluation process will be taken place. Therefore, this should be process of the project, process of the product, self-evaluation, and future development.

### 10.2. Critical Evaluation of the Process of the Project

Overall, this has been a very extensive; and long research to conduct throughout the planning, researching, investigating, learning, designing, and implementing every stage throughout this project. All of these stages that have been conducted would have been demonstrated within a project organised with an organisation. All of this would be to ensure the process for any chosen methodology would be followed throughout this project. At this moment, it has become very clear with the past modules have become clear to assist the process of going through this project.

Despite time consuming and length of this project, the process seems that objectives that have been researched are achieved throughout this project. I do acknowledge this at the fact that tailor made decisions have been decided to make sure that this project has been a success. Throughout this project, this project is aimed at students for University of Greenwich. Therefore, as this has been classified as colleagues and nor personal data has been used; it was beneficial to get a viewpoint of 46 questionnaires that have been sent out. I aimed to get around 50 questionnaires answered. Therefore, this objective has been met. Referring to Appendix A, this shows the results different questions that made a clear of the opinions that have been mentioned throughout the results that were received. All of these 46 results that submitted results were all colleagues of University of Greenwich. Therefore, as Appendix C shows that this should be all correct. This makes a clear indication with user testing of the improvements that were made to make a better encouragement and features for the final prototype. White and Black Box Testing were also tested too. All of these testing encouraged and enhanced the improvement of the application. However, I only included two user test cases. I felt that to improve this, I would encourage more test cases to get a better outlook and results the user testing that has been complete. However, it was encouraging to see that two students that reviewed the test cases gave encouraging feedback to help this project enhance even further. Besides, this would be the very first time that user testing within this format has been taken place. I felt that this was necessary for this project to enhance further features and feedback for this too. Therefore, I felt it was necessary to take place. This was also the same for Black-Box Testing too. An encouraging sign to see that new format of testing are taking place to ensure that further improvement have been taken. As this has been stated before, however, I will be stating this again to ensure that research has been approved. Referring to Appendix C, Georgios has approved of research with colleagues can be completed without ethical approval.

Another section that could have been improved would be product research. A discouraging sign is that having tried to search through the Play Store for similar applications, I could not find an application that was similar within this category. Therefore, this uniqueness presented a different problem that presented with different applications as mentioned. Due to time constraints, I would like to admit that I did not manage to surf the market as properly as I should have done. However, the application that have been presented show different features that have been assessed. This is one of the sections that could have improved further if an application with the use of NFC was presented.

Another encouraging process would be to have different languages that suit different type of users. Only one language that have been selected would be French. However, this would only cater to users that speak English and French. To enable this, all users would need to be able to change their language within the settings of their smartphones. Once this has been enabled, it would enable Healthy Tag to change the language from English to French. As stated, to improve this, it would be encouraging to highlight the most spoken languages within the world and highlight those languages. Therefore, it could cater to most users that speak different languages around the world.

### 10.3. Critical Evaluation of the Product

#### Strengths:

1. Firebase uses Realtime Database use
2. Ability to have a responsive design with different Android devices
3. Ability to integrate different languages such as French
4. Ability of searching through different products through Nuritionix API
5. Ability to filter products using calories
6. Ability to record calorie count by adding this on the current date through Google Calendar
7. Ability to change calorie goal within settings
8. Ability to track the scanned NFC tags
9. Ability to contact the developer for any issues with the application

#### Weaknesses:

1. History should be stored and remained
2. Ability of forgotten password
3. Ability to Share application through Google Play Store
4. Ability to use more of the API search

You may notice the difference and strengths that have been mentioned throughout the application. Many issues have been discussed throughout this application. However, some of the weaknesses should be reflected as improvements for future development. Some of these features that have been added throughout this application would be bonuses and considered strengths for this project. A point that I would like to make for the scanned history tags would be that numerous attempts were made to rectify this issue. I tried to store ensure that this was stored using **SharedPreferences**, however, there was an error preventing this from adding a list within this. As I spent most of this project focusing on the main elements to work, I had to ensure that the project and report were in sync and ensure that the main outcomes of the requirements worked. Please note that these changes were made whilst feedback was obtained during testing. Therefore, these issues were not rectified in time. Please note that the final Prototype shows additional screenshots and explanation with Appendix D for Chapter 12. Therefore, if you wish for further information, you can refer to this for further information.

### 10.4. Self-Evaluation

I believe that the whole project has been taught and conducted within the correct procedure. Different modules that have been revised over the modules that have been taught throughout this course. However, different modules found a way to investigate each stage that has been mentioned. One of the key areas that has been mentioned is the improvements from user testing. This was tested at a very late stage throughout this project. Therefore, it enabled last minute changes that only some of these changes were implemented. Therefore, one of the improvements would be to encourage time management to be better.

### 10.5. Future Development

Future development plays an integral part of a project. As this is only a prototype, numerous changes can be made by professional engineers to enhance this even better. However, one of the suggestions would be to encourage this further would be to include daily message reminders for breakfast, lunch, and dinner each day for users to encourage users to add their meal onto their calorie goal. Therefore, this would encourage users to use the application further. As you may notice, a very simple login has been presented. Different alternatives can be suggested as logging in through applications such as Google, and Facebook. Also, a recent feature that users tend to use would be to replace the login details with fingerprint scanner. This can be added further to enhance this application even better. Another suggestion to improve this application to make this more commercial would be to include Artificial Intelligence by selecting products that suit the users specifically. For example, if I aimed to lose weight, I would like the application to suggest different types of products that suit my taste. Therefore, this would make this application better

### 10.6. Conclusion

To conclude, this final year project has been a huge challenging experience over the few months. A valuable set of new skills has been integrated and developed further to encourage further learning and development throughout this project. A software development cycle helped encourage how to start and finish a project off. Thanks to this project, this will benefit users with nutritional improvement using NFC. A project of this process size has encouraged myself to complete further improvement.

The skills learnt through this project would be unforgettable and valuable experience for any student studying at University of Greenwich. The cycle has been unforgettable experience

## Chapter 11: References

Barzegari, A., Ebrahimi, M., Azizi, M. and Ranjbar, K., 2011. A study of nutrition knowledge, attitudes and food habits of college students. *World Applied Sciences Journal*, 15(7), pp.1012-1017.

BCS (2020) *Bcs.org*, [Online] Available at: <https://www.bcs.org/media/1062/chartered-it-professional-standard.pdf> (Accessed 23 August 2020).

British Heart Foundation. (2019). *Facts and figures*. [Online] Available at: <https://www.bhf.org.uk/for-professionals/press-centre/facts-and-figures> [Accessed 22 Sep. 2019].

Burgess, M. (2020) What is GDPR? The summary guide to GDPR compliance in the UK, *WIRED UK*, [online] Available at: <https://www.wired.co.uk/article/what-is-gdpr-uk-eu-legislation-compliance-summary-fines-2018> (Accessed 23 August 2020).

Change4Life, (2020) Google Play, Public Health England Digital. [Online] Available at: [https://play.google.com/store/apps/details?id=com.phe.c4lfoodsmart&hl=en\\_GB](https://play.google.com/store/apps/details?id=com.phe.c4lfoodsmart&hl=en_GB) (Accessed 30 July 2020)

Cohen, H., 2020. *Strategy Analytics: Contactless Payments Preferred Payment Method for Almost 30% Of US Consumers Post COVID-19*. [online] Businesswire.com. Available at: <<https://www.businesswire.com/news/home/20200706005370/en/Strategy-Analytics-Contactless-Payments-Preferred-Payment-Method>> [Accessed 29 August 2020].

Geambaşu, C.V., Jianu, I., Jianu, I. and Gavrilă, A., 2011. Influence factors for the choice of a software development methodology. *Accounting and Management Information Systems*, 10(4), pp.479-494.

Geven, A., Strassl, P., Ferro, B., Tscheligi, M. and Schwab, H., 2007, September. Experiencing real-world interaction: results from an NFC user experience field trial. In *Proceedings of the 9th international conference on Human computer interaction with mobile devices and services* (pp. 234-237).

GOV.UK. 2020. Coronavirus (COVID-19): safer travel guidance for passengers [Online] Available at: <<https://www.gov.uk/guidance/coronavirus-covid-19-safer-travel-guidance-for-passengers>> [Accessed 29 August 2020].

Haselsteiner, E. (2006). Security in Near Field Communication (NFC) Strengths and Weaknesses.

Ismael, N. (2018). Assessing Nutritional Awareness and Dietary Practices of College-aged Students for Developing an Effective Nutrition Educational Plan. *Canadian Journal of Clinical Nutrition*, [Online] 6(2), pp.22-42.

Kim, A. (2018) What is Human Computer Interaction (HCI), *Medium*, [Online] Available at: [https://medium.com/@annkim\\_93227/what-is-human-computer-interaction-hci-3020e5c29e5b](https://medium.com/@annkim_93227/what-is-human-computer-interaction-hci-3020e5c29e5b) (Accessed 3 July 2020).

Leonard, K. (2020) Examples of Ethical Issues in Business, *Small Business - Chron.com*, [Online] Available at: <https://smallbusiness.chron.com/examples-ethical-issues-business-24464.html> (Accessed 23 August 2020).

Levin, G. (2019) TOP 7 REST API Security Threats, *Restcase*, [Online] Available at: <https://blog.restcase.com/top-7-rest-api-security-threats/> (Accessed 3 July 2020).  
Merchant Savvy. (2020), 50+ Global Mobile Payment Stats, Data & Trends (Feb 2020), [online] Available at: <https://www.merchantsavvy.co.uk/mobile-payment-stats-trends/> (Accessed 11 July 2020).

MyFitnessPal, (2020) Google Play, Google Play, MyFitnessPal. [Online] Available at: [https://play.google.com/store/apps/details?id=com.myfitnesspal.android&hl=en\\_GB](https://play.google.com/store/apps/details?id=com.myfitnesspal.android&hl=en_GB) (Accessed 30 July 2020)

Nielsen, J., 1995. 10 usability heuristics for user interface design. *Nielsen Norman Group*, 1(1).  
Nutritionix, (2020) *Nutritionix.com*, [Online] Available at: <https://www.nutritionix.com/> (Accessed 11 July 2020).

Ok, Kerem & Aydin, Mehmet & Coskun, Vedat & Ozdenizci, Busra. (2011). Exploring Underlying Values of NFC Applications. *3rd International Conference on Information and Financial Engineering* (Accessed on 25<sup>th</sup> June 2020)

Oslen, N., 2018. *How Many Carbs Should You Eat Each Day to Lose Weight?* [Online] Medicalnewstoday.com. Available at: <<https://www.medicalnewstoday.com/articles/320773#good-carbs-vs-bad-carbs>> [Accessed 29 August 2020].

REST API, (2020) [Online] Available at: [https://www.seobility.net/en/wiki/REST\\_API#The\\_six\\_principles\\_of\\_REST](https://www.seobility.net/en/wiki/REST_API#The_six_principles_of_REST) (Accessed 2 July 2020).  
Thanapal, P., Prabhu, J. and Jakhar, M., 2017, November. A survey on barcode RFID and NFC. In *IOP Conference Series: Materials Science and Engineering*.

Track - Calorie Counter, (2020) Google Play, Nutritionix. [Online] Available at: [https://play.google.com/store/apps/details?id=com.nutritionix.nixtrack&hl=en\\_GB](https://play.google.com/store/apps/details?id=com.nutritionix.nixtrack&hl=en_GB) (Accessed 30 July 2020)

Wetzlinger, W., Auinger, A. and Dörflinger, M. (2014) Comparing Effectiveness, Efficiency, Ease of Use, Usability and User Experience When Using Tablets and Laptops, *Design, User Experience, and Usability. Theories, Methods, and Tools for Designing the User Experience*, pp. 402-412.

Wills, B. (2020) What is MoSCoW Prioritization? | Overview of the MoSCoW Method, *Productplan.com*, [Online] Available at: <https://www.productplan.com/glossary/moscow-prioritization/> (Accessed 19 June 2020).

Wyatt, M. (2020) What is an API? The (Complete) Application Programming Interface Definition, *The BigCommerce Blog*, [Online] Available at: <https://www.bigcommerce.co.uk/blog/what-is-an-api/#what-is-an-api> (Accessed 2 July 2020).

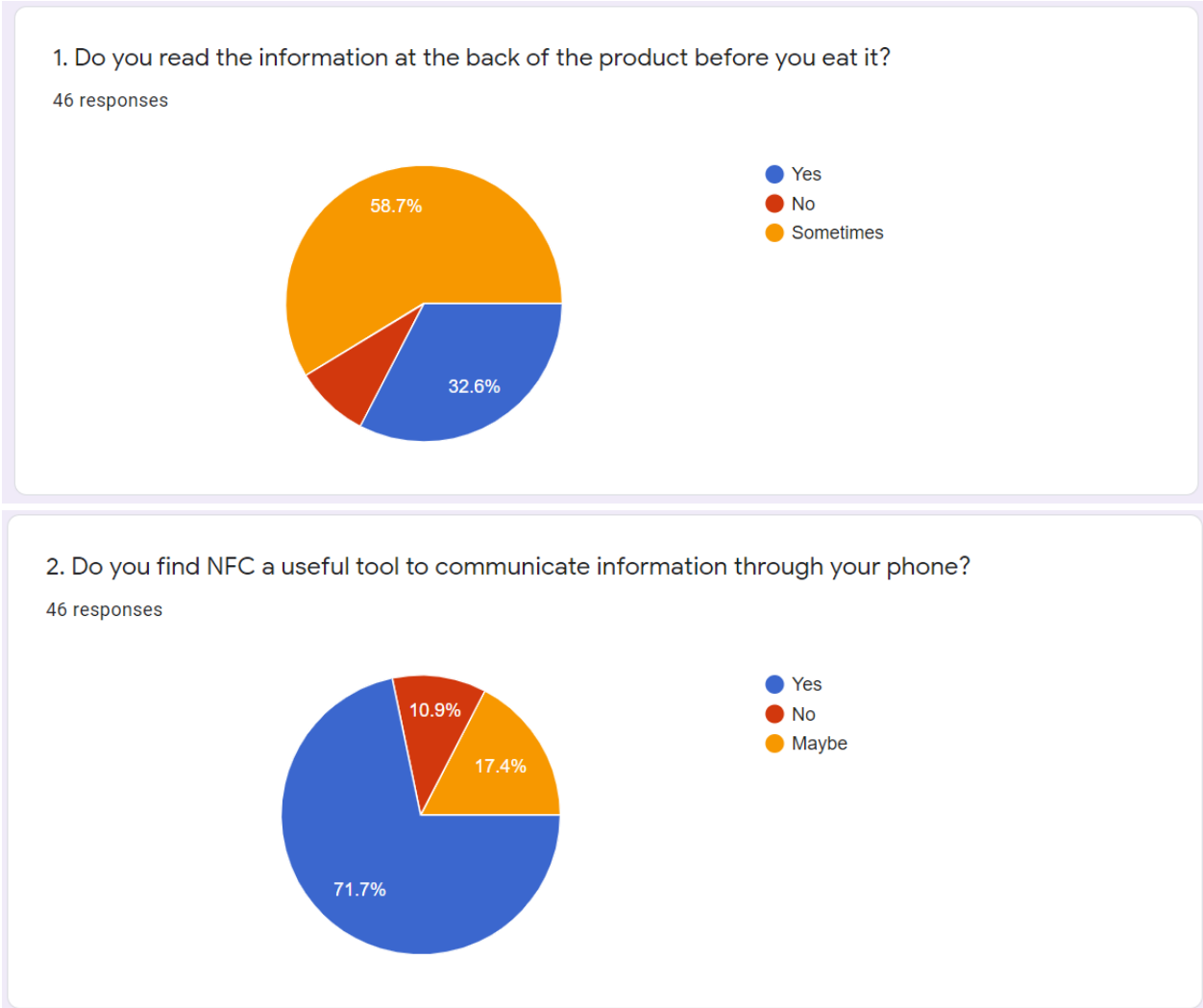


Chapter 12: Appendices

12.1. Appendix A – Questionnaire Results

You may find the link to the questionnaire that was send out to students here:

<https://docs.google.com/forms/d/1PE8DVw4u55bPpg3JrwV0O-v1txYIkpnAMWvVnewZGgE/edit#responses>



### 3. If not, why not?

8 responses

N/A

Never used it

Not in my general list of useful tools

I don't use it often

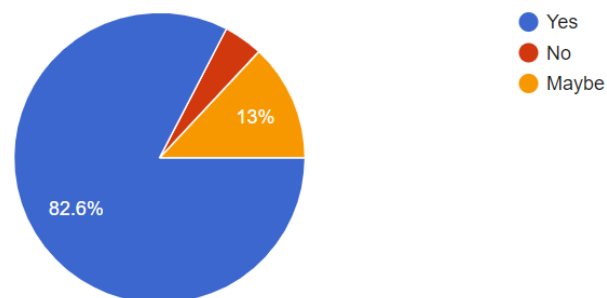
Never had a reason to use it

I don't really know what it is, therefore I can't really say that it's a useful tool or not.

Due to power consumption of using bluetooth, the app itself will need to more informative than interactive, however NFC does have uses such as checking the next available bus.

### 4. Would you like to scan an item by using NFC to find out more information about the product?

46 responses



5. What type of information would you like to see? For example, snickers bar – sugar amount

46 responses

Calories

Calories and price

Sugar intake, calories, fats- all general nutritional value and maybe where the product has been made/come from

sugar, protein, carbohydrates

Allergens, sugar, ingredients

Calories, fat, sugar etc

Calorie amount, if it's vegan/vegetarian/dairy free

Calories

Not sure of the value proposition - would this scan unopened products? In this case I personally see little

6. How would you like to be informed on the nutritional facts of an item scanned using NFC? e.g. good or bad

46 responses

Good

Good

I want to see graphs and figures that show me exactly how much calories I have left for the day and how much this one product takes up from that recommended daily calorie figure.

Colour scheme- red, orange, green

rate out of 5

Anything simple green or red etc

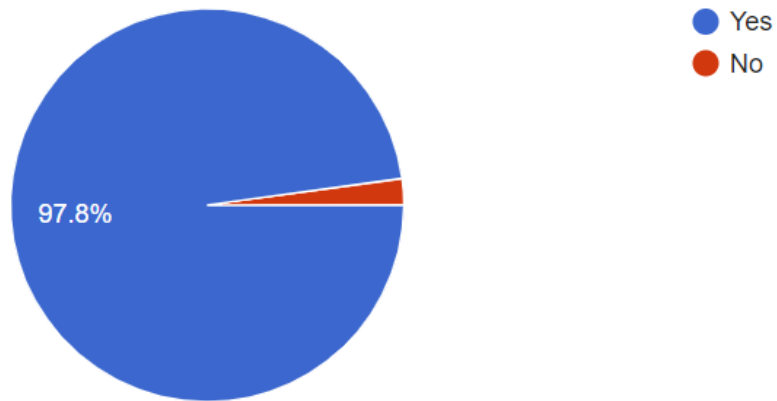
Low medium high

The exact amount or if it is vegan/vegetarian

Not really sure what the question is asking. I would like nutritional info but I can see that anyway quicker by

## 8. Would you like to know what type of items you have scanned as history?

46 responses



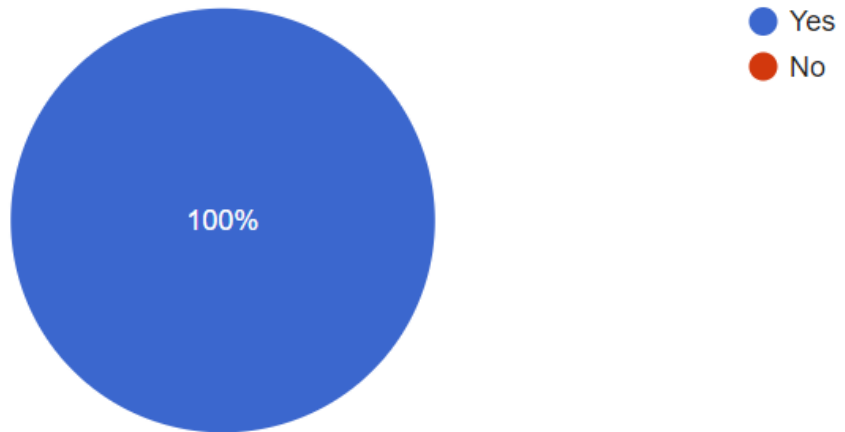
## 9. What other types of assessments would you like to see? Any suggestions are welcome e.g. profile

46 responses

Profile
N/a
N/A
A daily goal or a recommended item of the day that is healthy.
Calorie tracker, measuring your intake based on past weeks/days so you can see progress or where you've eaten badly
profile, login, manual entry if not found
A health profile/ where you can input Individual health needs
Maybe a tracker of what we have scanned and eaten
Not sure

## 10. Do you like the idea and goal of this project?

46 responses



---

## 11. If not, what suggestions do you have to improve the product?

10 responses

Sounds really good. I think there's some similar ones out there such as MyFitnessPal but that app is quite boring so I would recommend some different features. Maybe a social page where you can recommend food to your friends etc

no

Would be a super helpful tool if it worked To notify the user if food was suitable for vegans/ special dietary requirements (halal kosher etc)

N/A

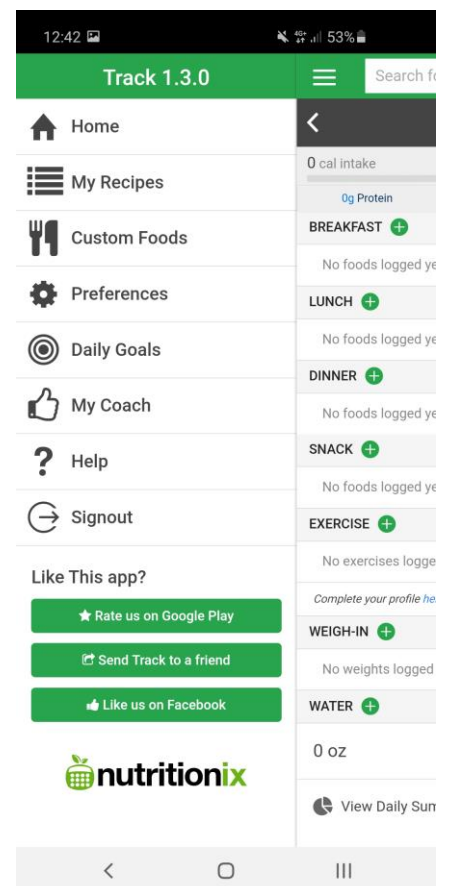
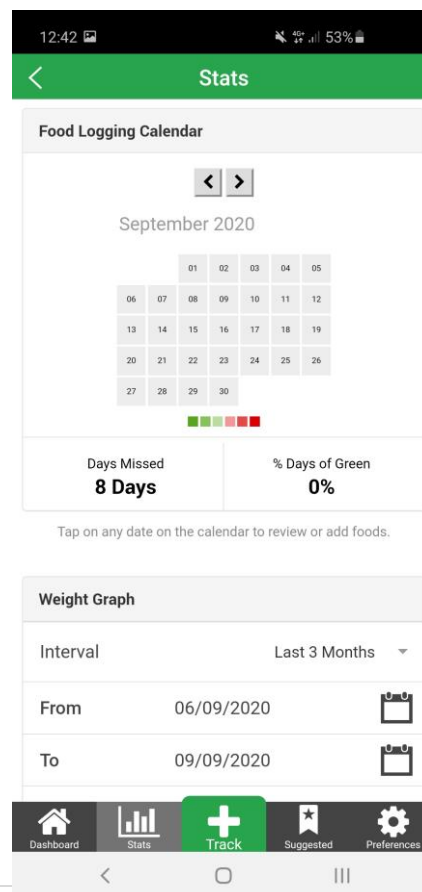
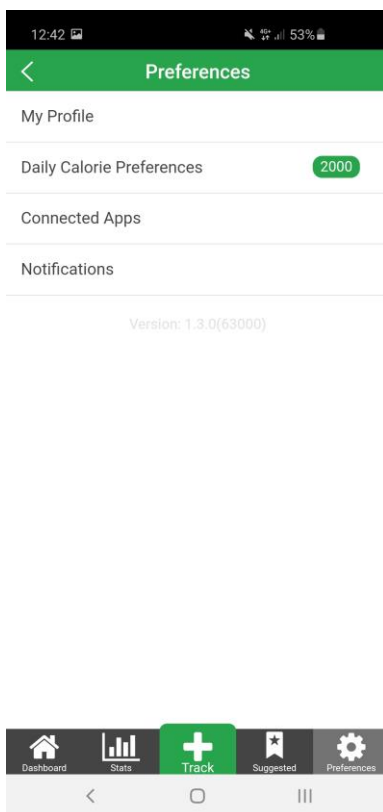
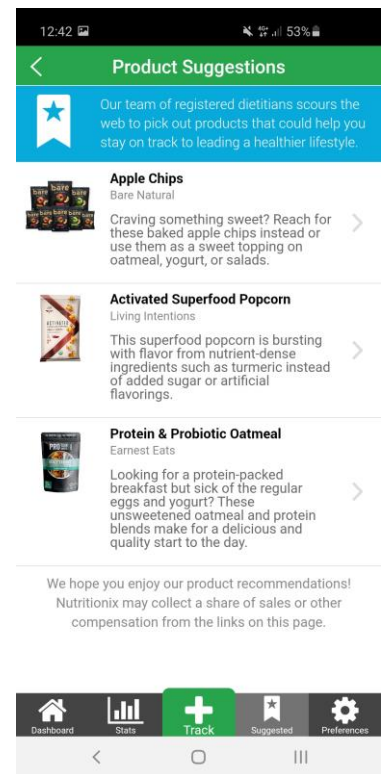
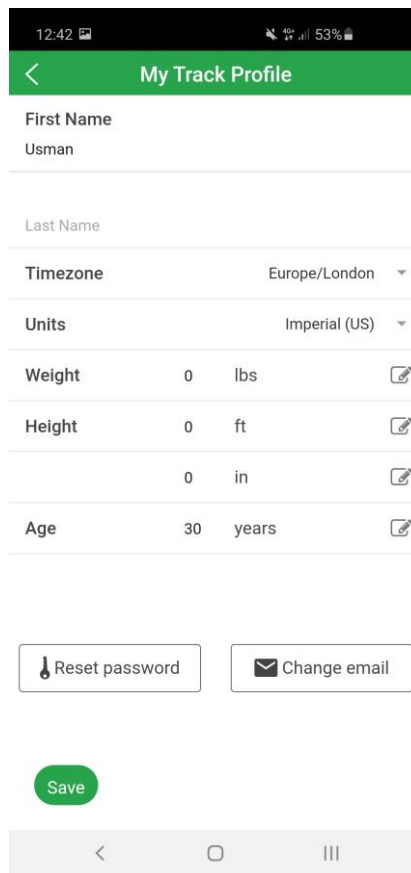
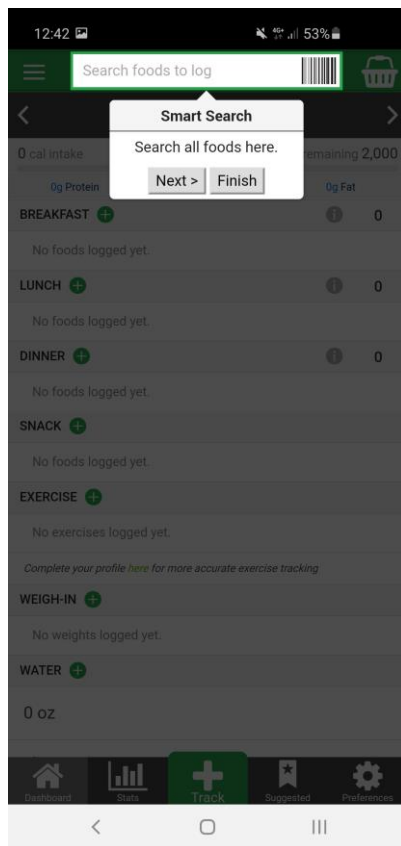
No improvements, just implement what I added above on question 6 and question 9.

Track your phone if lost whilst shopping. It happens.

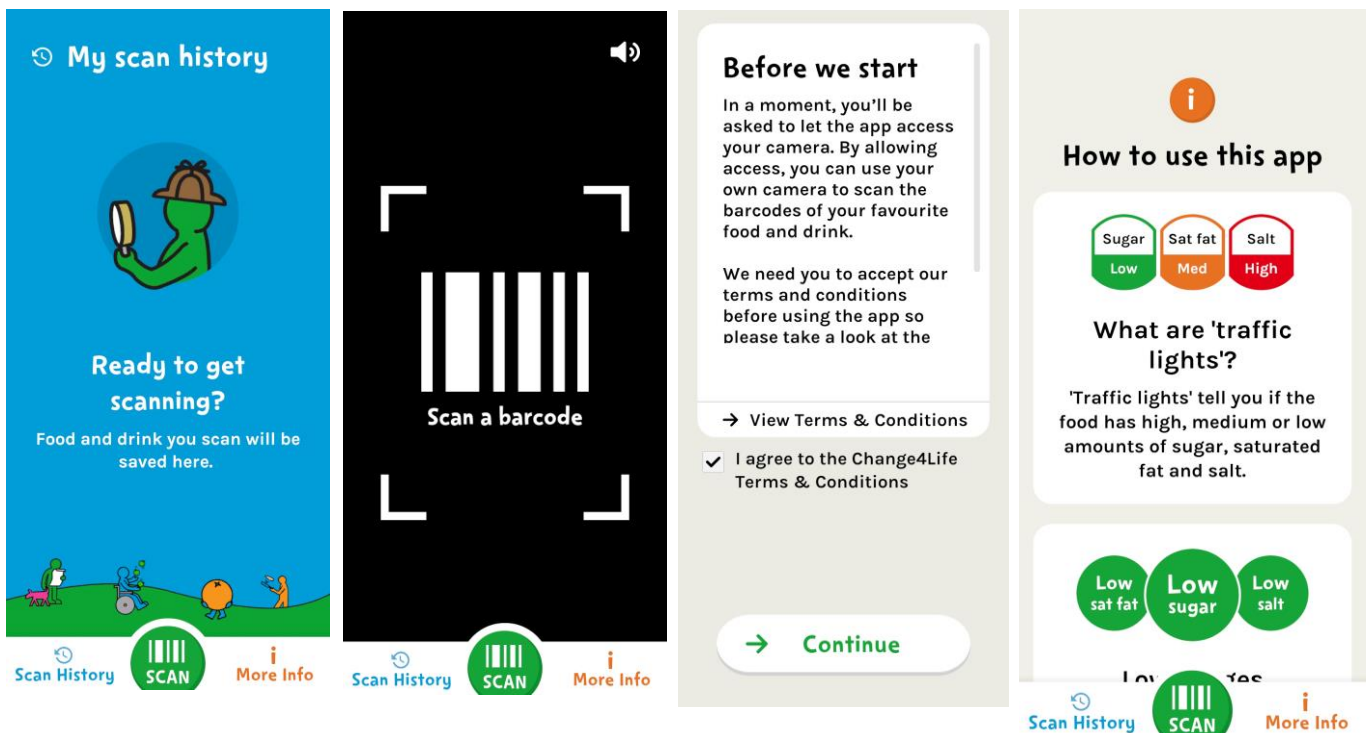
Not needed

## 12.2. Appendix B – Product Research Appearance

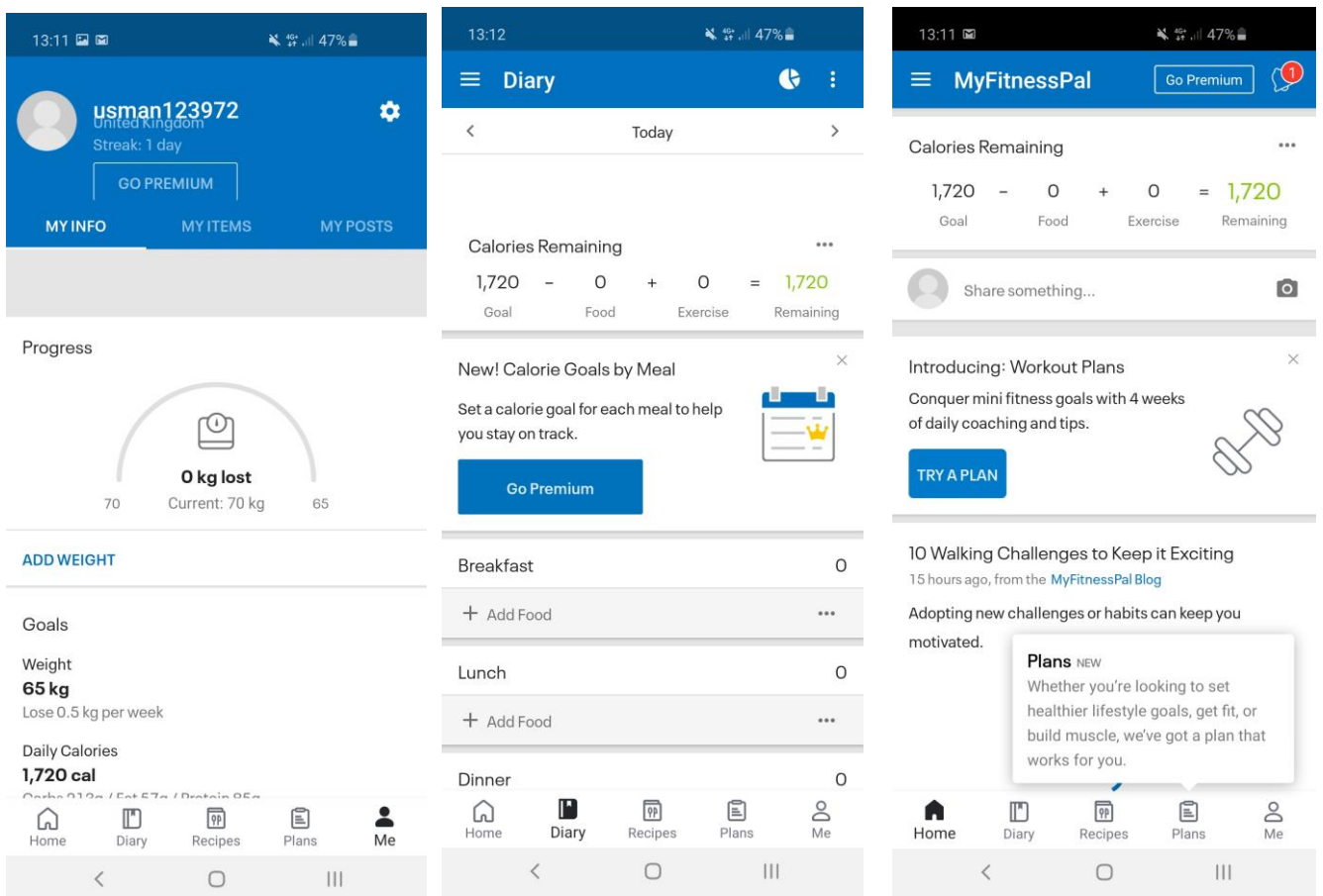
### 12.2.1. Calorie Counter



### 12.2.2. Change4Life



### 12.2.3. MyFitnessPal



## 12.3. Appendix C – Ethical Approval



**Georgios Samakovitis** <G.Samakovitis@greenwich.ac.uk>  
to me, Tatiana ▾

Thu, 18 Jun, 12:05 ★ ↩ ⋮

Hello,

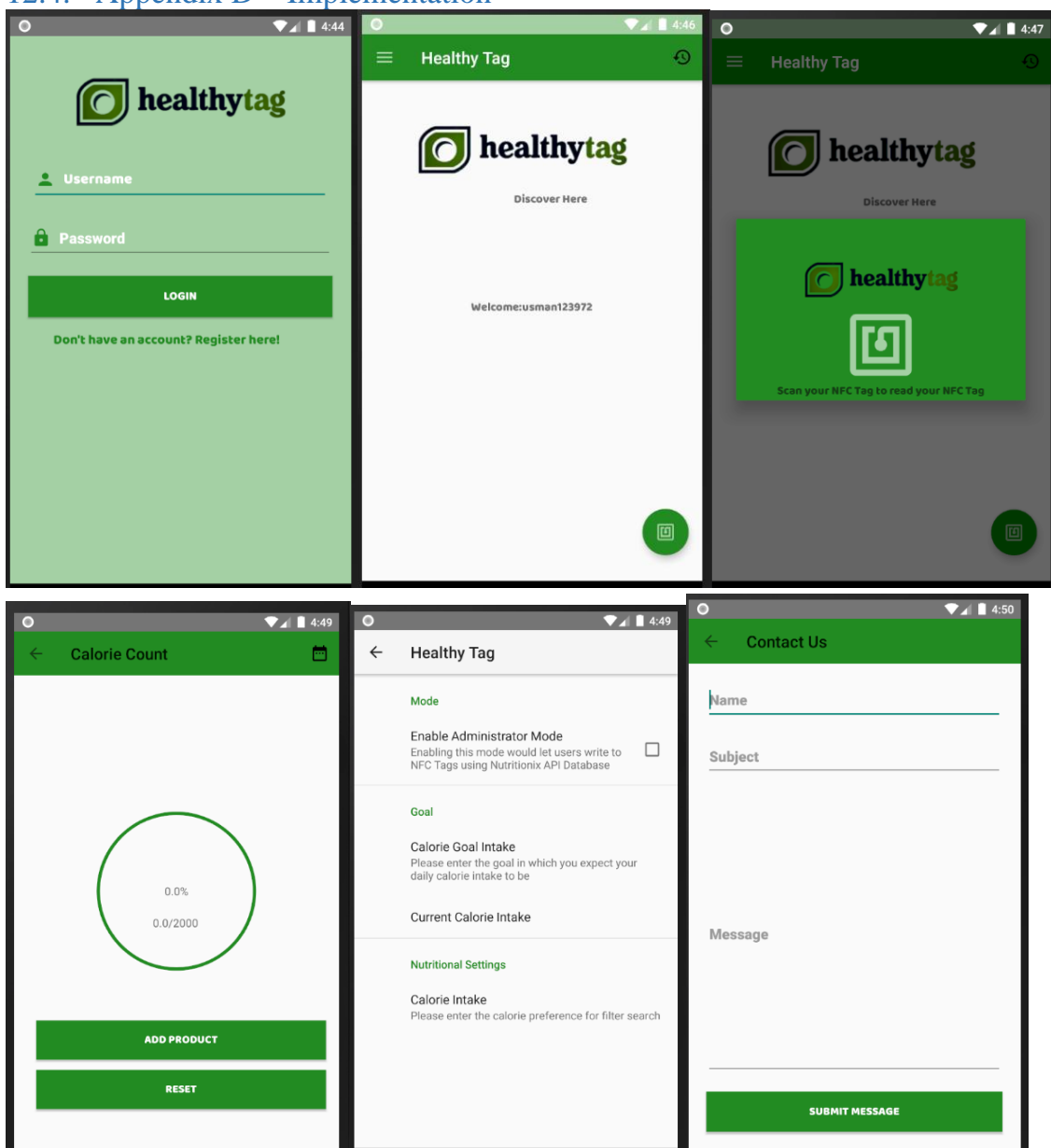
I understand, Usman, that you will give this to your colleagues at University + you are not asking for or collecting any personal data.  
If that is the case, then you don't need Research Ethics approval.

If I got this wrong, and you ARE involving externals, then the form needs

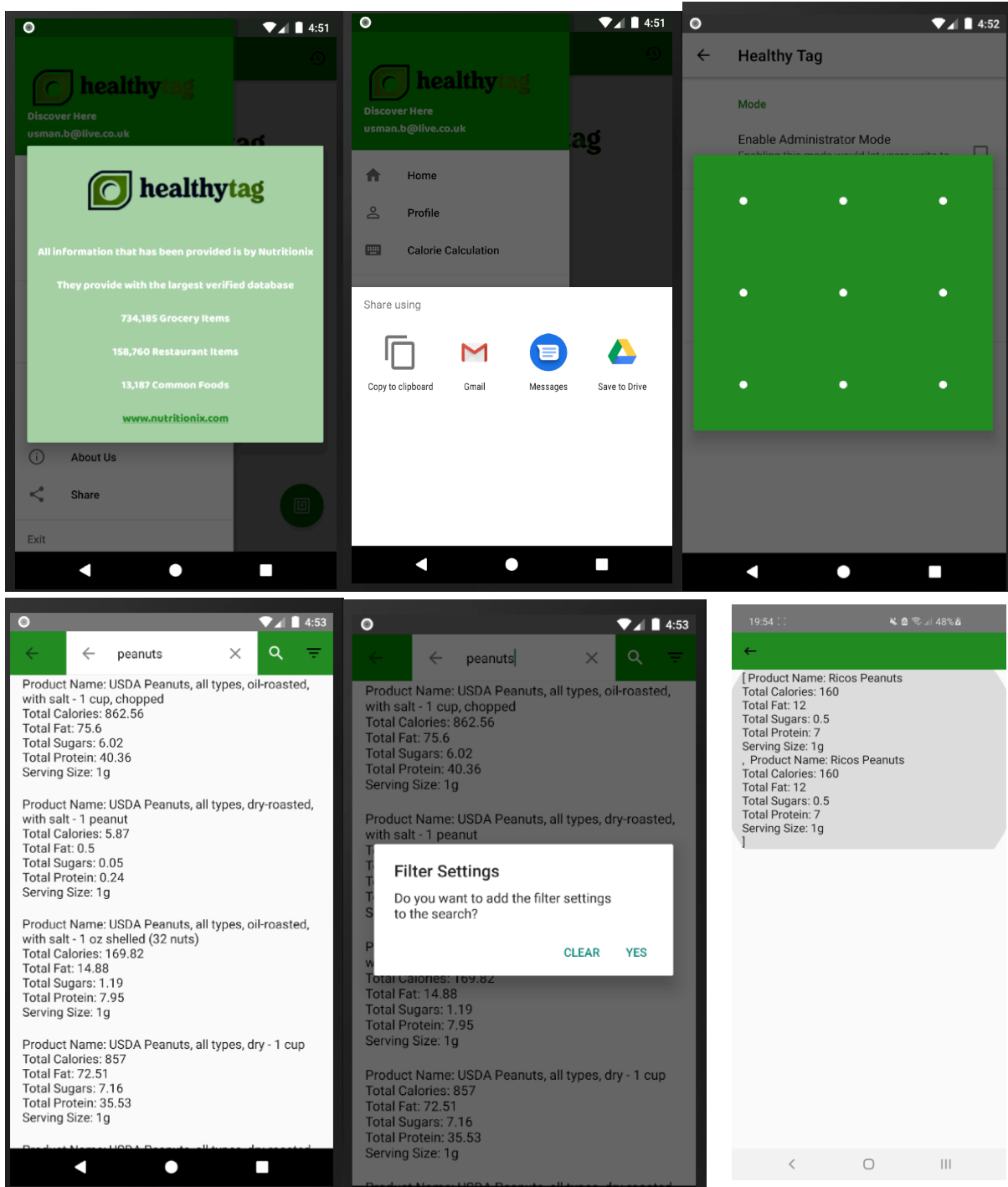
1. one change in section 3: Does this project involve human participants? YES
2. You also need to either get signature by Markus, or CC him in the email so all are onboard.

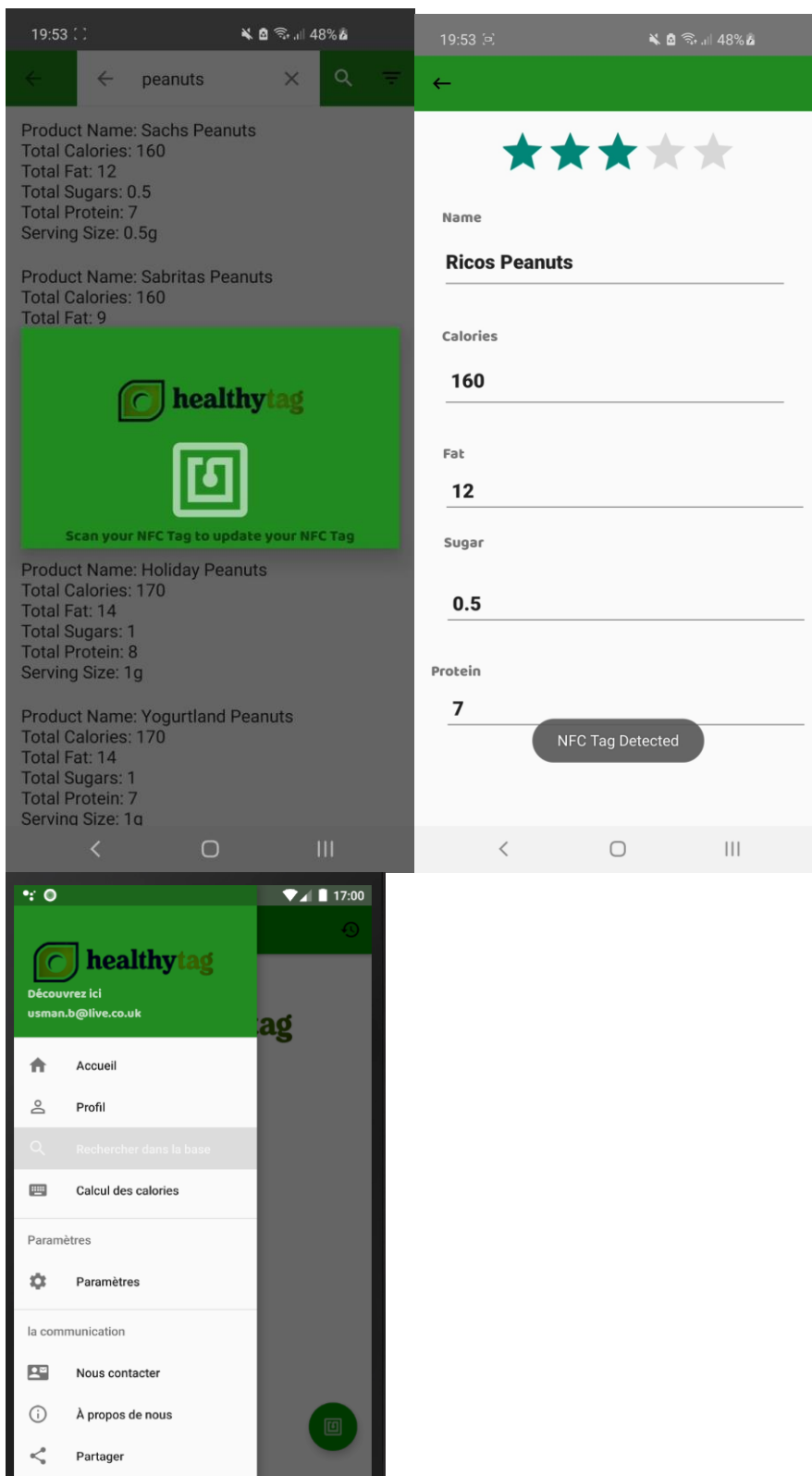
Let me know  
best  
George

## 12.4. Appendix D – Implementation









You can view the link that is a video demonstration of Healthy Tag as this was sent to Markus Wolf and Elena Popa too here:

<https://drive.google.com/file/d/1Fc8P1d1FfCR2HIJzRJP1lucyYIxnVTmyI/view?usp=sharing>